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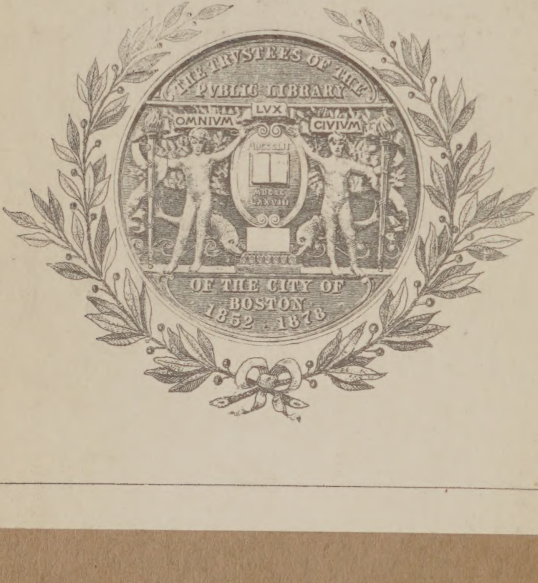
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GROWTH AND EDUCATION

GROWTH AND EDUCATION

BY

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PREFACE

Some years ago I became greatly interested in the question how a child grows. Principal Burk's monographs gave full information concerning growth in height and weight, and concerning some of the most important changes in the nervous system. Professor Donaldson had told us of the growth of the brain. Concerning the growth of heart, lungs, and other organs, I could find at first but little information. I found an abundance of books concerning diseases of children, but not one attempting to give a complete account of the growth of all the systems in the normal or average child.

It looked as if we had been rearing and training our children without ever asking whether the child entering school was merely a small edition of the adult, or something quite different. We seemed to have been attempting by education at home and at school to supply the child's needs without having first asked what those needs were, and whether they differed slightly or greatly at different ages.

It seemed to be of the greatest importance to discover first of all whether all organs needed exercise equally at all ages, or whether every organ had its special epoch or epochs when exercise was more profitable than earlier or later. In the latter case we needed to know what organs at every epoch most needed exercise, and of what kind and amount. Furthermore, it would be useful to parents and teachers to know whether children and youth have the same or steadily increasing vigor, endurance, and power of resisting disease or adverse conditions at all ages, or whether there are periods of less power of resistance, when leniency and care are necessary.

Later I became surprised at the large amount of material concerning the growth of different organs and systems which is scattered through medical and other journals or in separate monographs. The chapters in this volume on the growth of the child are based on a large amount of this material arranged and tabulated. At first I intended to publish the tables as an appendix in this volume. But I preferred to defer their publication until I had gathered much more material and had gained answers to certain important but difficult questions.

I have taken for granted the often forgotten or neglected axiom that a healthy physical growth and development are during childhood more important than any amount of learning. In the first chapter I have tried to show that physical training and education are more needed to-day than ever before. The facts of human evolution, briefly discussed in the second chapter, seem to prove that, until the human stage is fully attained, the muscular system is the head and the strategic centre of development rather than the brain. In other words, the brain is developed through the exercise of the sense-organs and the muscles rather than these through the training of the brain. In this respect the young child resembles the animal. If the higher mental powers of the brain do not awaken until the eleventh or twelfth year, it is of little use to attempt to train them before this time. If, during all these earlier years, the muscles are needing and craving exercise, we certainly should do well to meet and satisfy these needs.

The balance of organs in the child's body, in other words his constitution in the literal derivative sense, is quite different at different epochs. The great mental changes during youth and early manhood are familiar to us all. The physical changes during childhood and early youth are equally great, but often pass unnoticed or but poorly understood. Yet these physical changes modify or cause certain traits in the child. What appears to us carelessness or clownishness in gait or behavior may be due to immature muscles. Poor eyesight and defective hearing often cause the child to be considered stupid. The young girl is often blamed for lack of application when the real cause of her poor success in school work is lack of outdoor exercise and of sufficient lung capacity.

We wisely desire that our children should form right habits of physical, mental, and moral behavior. This is well. But let us not forget that the child must think and act as a child. Most of his childish instincts and cravings are wise and healthy, even though they appear rude and unsatisfactory to us. What appears faulty, when judged by adult standards, may be normal, natural, and beneficent in the child. Many of his failings are due to immaturity, and he will outgrow them of himself in due time. We need to learn when not to notice, as well as when and how to correct. The parent who knows and understands the laws of growth will have more faith, hope, and courage, and will be spared much needless anxiety.

When one has studied the different epochs of child life, he cannot fail to see how admirably the life on the New England farm a half-century ago was fitted to promote physical and mental growth and development. The debt of New England to the farm has never been duly recognized. The preponderance of town and city, and the changes in farm life, have resulted in the loss of certain elements of the education of our fathers which we can very ill afford to spare. These losses have greatly decreased the efficiency of the home in education, and have thrown a far heavier burden of responsibility on the school. Hence our education is often criticised as unpractical and not suited to fit boys and girls for life. The present condition is certainly not the fault of the teachers, nor altogether that of the parents. New burdens have been thrown upon the school almost without warning. The educator has to face new and very difficult problems. Our present system has not been able to reform and change front quickly enough to meet the new emergency. But the emergency must be met, and it will be met mainly by the school. Hence parents and teachers need to know and understand one another; and to work in harmony, unison, and mutual help and support.

This book is intended to be an introduction to the study of the growth of the child. Hence the most important part of it is the bibliography. If I can introduce teachers and parents to the monographs and articles cited, I shall surely have done them a service. I have attempted to select articles which are accessible, accurate, and trustworthy, and not too technical. I am well aware of the incompleteness of the bibliography. Much of whatever excellence it may possess is due to the great kindness and patience of Dr. Louis N. Wilson, Librarian of Clark University. I am under great obligation to him and his assistants for many services and acts of kindness.

I wish to express my thanks to President G. Stanley Hall for many helpful suggestions and for his unfailing kindness and encouragement. I am under great obligation to Drs. Hitchcock, Holt, Porter, Hastings, and Hall, for permission to use the material in the tables. I wish to thank Dr. E. M. Hartwell for permission to use his table of mortality of Boston children. Part of the material has been used in lectures in Boston, under the auspices of the Committee of Education of the Twentieth Century Club. To them I am very grateful for a great opportunity and for many kindnesses.

J. M. T.

AMHERST, MASSACHUSETTS, 1907.

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GROWTH AND EDUCATION

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CHAPTER I

PRESENT NEEDS IN EDUCATION

It was a favorite maxim of Socrates that, if a thing is good, it surely must be good for something. What is an education good for? This much-abused word has been used in many senses. Its definitions vary greatly. Higher mammals were educated by their parents before man appeared on the globe. The lowest savage tribes educate their children, and their systems of education are often interesting and instructive. Great thinkers from the most remote times have written on the subject. But we are still disputing over definitions, and the ideal system has not yet been discovered.

What we most need is not so much a complete, accurate definition, as some criterion by which we can test our present systems and methods, and see whether they are accomplishing all that we can reasonably expect from them. Our test must be one which can be easily and readily applied, if it is to be of practical use. This thought of Socrates, that a good thing must be good for something, may, perhaps, furnish us a standpoint from which we may wisely view our present systems, and seek to discover possible improvements.

If any one could discover or frame a system of education which would enable the child and the man to avoid or to cope with the dangers of life, and to seize its opportunities; in one word, to meet its emergencies successfully, he would evidently render us a great service. Such a system would be exceedingly useful. Seizing the opportunities of life means making the most of ourselves physically, mentally, and morally; it implies health, vigor, and power; knowledge and wisdom; goodness and love; use, service, and the highest joy. It means making the most and best of this goodly world in which we live, and framing from our surroundings an environment to which we may wisely conform, and hence survive and progress. Opportunity is limitless; we fail to recognize and grasp it.

But the dangers and opportunities, in one word the emergencies, of state and individual are not the same in different places and times. Every state frames its system of education to meet its own dangers and to grasp its special opportunities, and to enable its citizens to do the same. The dangers of the German state and citizen are evidently not the same as ours. A nation in the middle of Europe, with few natural boundaries and surrounded by warlike neighbors, has dangers which we find it hard to appreciate. Differences in soil, climate, and natural advantages, in government, traditions, and social conditions, give to the individual citizen opportunities and emergencies different from ours. Hence a system of education which would be exactly suited to German needs would not suit American conditions. We may learn much from the German, and he from us; but neither one of us can safely copy the other. We have our own dangers and opportunities, and must meet them as best we may.

Similarly a system of education suited to the needs of one period of our national development will naturally be inadequate when conditions have changed to any great extent. In the eighteenth century New England was peopled with a comparatively homogeneous English stock. It was as vigorous, sturdy, and tough a race as the world has ever seen. English climate and conditions had given it marvelous strength and endurance. The boldest and most vigorous had been sifted out for the planting of the New World. It was leading an agricultural life, of manual labor, largely in the open air of the country. The birth-rate was very high, and the population increased with marvelous rapidity.[1] The transfer of the somewhat heavy English Puritan stock to the nerve-tonic of our bracing air, new conditions and emergencies, and the spur of necessity, had roused all the mental powers of this marvelous people. They were keen, quick, shrewd, inventive.

They were scattered in small towns and villages, each one of which was more remote from its nearest neighbor than is New York from Boston or Chicago to-day. Every village was fringed with farms scattered over the hills, wherever a man could wring a living from the soil between the ledges. Wealth and luxury were almost unknown, the farms furnished the necessities of life. Behind them stretched the wilderness, tempting the adventurous as well as the shiftless to a life of barbarism, if not of savagery. Educated men were rare, books few and expensive. No wonder that the first settlers feared that learning would be buried in the graves of their ministers. Illiteracy and barbarism were very real dangers in those days; from wealth, luxury, and the evils of overcrowding they had little to fear.

The stress and strain of life bore heaviest on the tough muscular system. This rested and recovered quickly, for the sleep of the laboring man was sweet. There was little competition. Life was simple, often very monotonous. Even an Indian raid must have been a welcome change. Opportunities were few. Children looked forward to the time when they would clear a farm, and establish a household, as their fathers had done before them.

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[1] Walker, "Restriction of Immigration," *Atlantic*, vol. lxxvii, 1896.

These Puritan ancestors of ours were not all saints. They often drank heavily, quarreled outrageously, and varied the monotony of respectability by the rudest outbursts of animal, if not beastly, tendencies. Even their wit and jokes were often cruel. Those who disagreed with them were summarily banished. Life is certainly much pleasanter in the twentieth century.

Education was gained mostly at home. In the large families the children educated one another. The farm offered more opportunities for physical exercise than the child or boy wished. His labor was needed; "he was a member of the firm." When the forest had been cleared, the stumps burned or uprooted, and the walls built, there were endless jobs for him. Stones had to be picked up, and every plowing brought up a new crop. The animals had to be cared for, wood and kindlings had to be provided daily. All the light work fell upon the children. Very early they shared, as far as possible, the labor of the adults. Nature study was forced upon them.

The farm was a hive or laboratory of manual training.[1] The farmer and his boys had to be carpenters, cabinet-makers, blacksmiths, wood-turners, chair-seaters, basket-makers, all at once. There was hardly a trade or handicraft of which they did not have some experience. Responsibility fell upon them early, and they had to meet countless emergencies as best they could. Necessity was the mother of invention. The girls did housework, spun and wove; made butter and cheese; learned to dye, and bake, and brew. They were often as good farmers as their brothers. Boys and girls had to make their own playthings, as well as a host of other things for the whole family.

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[1] Hall, "Boy-Life in a Country Town a Quarter of a Century Ago," *Proc. Am. Ant. Soc.*, Worcester, October, 1890; Abstract in *Ped. Sem.* i, 232; Bailey, *Outlook to Nature*, p. 154.

President Hall[1] in his article on Moral Education has well said: "Ten days at the hoe-handle, axe, or pitchfork, as an eminent educator has said in substance, with no new impression from without and one constant and only duty, is a schooling in perseverance and sustained effort such as few boys now get in any shape."

The child saw but few books at home. The Bible was the usual library, with one or two volumes of sermons, and perhaps "Pilgrim's Progress" for fiction. A book was a rarity and a treasure. Learning was possible only for the very few. The child respected and coveted it as much as his father or mother did. The very best use of the few weeks spent in school was to devote it wholly to book-study. It is very unfortunate that so well-balanced, wise, and practical a system of education is no longer possible.

The dangers and opportunities of the twentieth century are quite other than those of the eighteenth. Mr. Gladstone[2] estimated that as much real wealth was produced during the first half of the nineteenth century as during the preceding eighteen hundred years. An equal amount was produced during the next quarter-century. Probably quite as much has been added since 1875. Between 1860 and 1880 the wealth of the United States increased three times as fast as its population.

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[1] Hall, "Moral Education and Will-Training," *Ped. Sem.* ii, 73.
[2] Loomis, *Modern Cities*, p. 43.

As wealth increases, men are no longer content with food and raiment. There is a steadily increasing demand for manufactured articles, and more money for their purchase. Hence the growth of factories, the crowding of population in manufacturing centres, and the consequent dangers to health and morals.

New means of communication have made the fertile prairies accessible, agricultural tools and machinery have been invented or improved. It has been estimated that the average farmer with horses can do with three men the work formerly done by fourteen, and can do it better. The Eastern farmer cannot compete with his Western brother. This means displacement of population on a grand scale. The people, especially the energetic, ambitious, and strongest intellectually, pour from the country into the city.

President Carroll D. Wright[1] tells us that between 1790 and 1880 the population of the United States increased about sixteen-fold; the population of cities and towns having more than 8000 inhabitants increased almost 140-fold. In 1790 about one thirty-third of the population lived in such towns and cities; in 1890 about one third. In 1890 there were about seventy-five times as many towns and cities as in 1790. In 1870 there were fourteen cities having more than 100,000 inhabitants; in 1880, twenty; in 1890, twenty-eight. More than one half of the population of the North Atlantic States live in towns or cities. In some or most of these states the rural population has actually decreased.

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[1] Wright, "Lessons from the Census," *Pop. Sci. Mo.*, xlvi, 459.

The great city, with its vast opportunities for good and evil, its wealth and luxury, its poverty and misery, its vice and crime, with its heterogeneous population, and contrasts of race, creed, class, and condition, has confronted us suddenly with its almost insoluble problems. Life in a great city has its advantages, but the poor are many, and their condition is often sad enough.

Read the report of the Council of Hygiene to the Citizens' Association as to the sanitary condition of the tenements of the city of New York in 1867.[1] It speaks of them as rapidly becoming the "nests of fever and infection, and the poisonous abodes of physical decay." The Tenement House Commission of 1900 reports that the present type of tenement gives to its occupants less light and less ventilation, less fire protection and less comfortable surroundings than the average tenement of fifty years ago.[2] The air of the great city is spoiled by smoke, decay, and germs; sunshine is kept out of the deep and narrow streets, soil and ground water are polluted. No wonder that the death-rate of London rises alarmingly when fogs blanket the city. No wonder that the death-rate from consumption for the state of New York was not far from twice as great in cities of over 25,000 inhabitants as in the rest of the state.[1] Let us not forget that consumption is not merely a death-scourge, but a symptom of bad heredity and surroundings, and of weak constitution. There is some reason to fear that cities having a population of 50,000 to 100,000 inhabitants are less healthy than the largest. They appear to have overstepped the danger limit in size without having yet taken proper sanitary precautions.

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[1] Loomis, *Modern Cities*, p. 36.

[2] *First Report of the Tenement House Department of the City of New York*, pp. 5, 6.

How many children go to school breakfastless, or at least hungry? Mr. Hunter guesses 50,000 in New York City. Let us hope and cheerfully assume that he has greatly exaggerated the number. It is a fair-sized army in one city alone. A parliamentary committee reports even worse conditions in manufacturing cities in England. These children grow up weak, stunted, inefficient, hopeless. They fill our poor-houses, reformatories, and jails. They become the derelicts of society. They will have children like themselves, or weaker.

But the poor are not the only sufferers. The great middle class is in some respects at a still greater disadvantage. The children of the poor play in the streets. The child of the middle class is usually not allowed this advantage. He finds very little useful employment or exercise. He is almost entirely deprived of active and vigorous play or work in the open air during the years when he most needs these opportunities.

It is a fact beyond all doubt that a very large fraction of our population has exchanged rural for urban life during the last two generations. It is equally indisputable that, as fast as we can, we are exchanging a life of muscular effort in the open air for one of brain-work indoors. We avoid manual labor. The farms are deserted; store, office, and desks are crowded. Operatives in our factories object to having their children receive manual training; they wish them to gain accomplishments which will fit them for business or professional life. We can hardly blame them.

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[1] *Handbook of Prevention of Tuberculosis*, p. 74.

We have exchanged a life of simplicity and monotony for one of great variety and complexity. The strain, which used to be mainly muscular, now rests heaviest on the youngest and most delicate portions of the nervous system. This strain is very severe. Professor Huxley has well said that the struggle for comfort is far more cruel than the struggle for existence. Competition and a feverish longing for wealth and luxury, accompanied by discontent, fret, and worry, diminish the joy and increase the wear of work. Such a revolution in our habits and conditions of life affects the balance and working of all our organs.

Dr. Baxter,[1] in his report of the Provost-Marshal-General's Bureau, tells us that nearly three fourths of all the teachers examined as to their fitness for military service in the War of the Rebellion were rejected as unfit; of physicians and clergymen, two thirds; of laborers and farmers, one third. There is, he continues, a steady increase of disease as we ascend the so-called social scale from the man who works with his heavy muscles only to those who rely on cerebral to the practical exclusion of muscular work. Even if the profession is the refuge of the weak, as Dr. Baxter suggests, and not the cause of their weakness, the child of the professional man is in danger, at least, of inheriting a low tone of vitality.

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[1] Baxter, *Medical Statistics of the Provost-Marshal-General's Bureau*, i, chart xxxiv.

It seems clear that nervousness in the sense of nervous weakness or fatigue, or of lack of nervous strength and endurance, has increased rapidly during the last half-century.[1] As Beard has shown, its cause is modern civilization with its haste, worry, and strain upon the highest, finest, and weakest brain centres. Supplementary causes are a dry, bracing climate, and our social, political, and religious institutions and habits.

The signs of this increasing weakness, or of decrease of resisting power, are clear and many. We cannot endure the amount of alcoholic drinks, narcotics, drugs, or excesses which our ancestors tolerated. Sensitiveness to heat and cold, insomnia and early breakdown, premature baldness, point in the same direction. Even the fine, "chiseled" features and the quick, mobile play of expression of our American girls are signs of a dangerously sensitive nervous system. Thus Beard argues, and there is certainly some ground for his conclusions.

But it is very probable that the nervous system is affected by sedentary life to a large extent indirectly through the weakening of the digestive and assimilative powers. The sedentary man or woman can digest only the lightest food. The essential fats are almost tabooed; pork is fast becoming intolerable. Without abundant air and exercise a sound digestion is, of course, impossible. We crave concentrated and stimulating foods, especially the albuminoids of meat. The excess of albumen brings a heavy strain on the kidneys, and they weaken and become diseased. The incompletely digested food ferments in the alimentary canal, and the whole body, especially the brain, is poisoned or depressed. Sedentary workers suffer greatly from constipation, which leads to similar results. Hence the commonness of nervous dyspepsia, a double root of every sort of evil and mischief. With such conditions and modes of life, anything very different is hardly to be expected.

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[1] Beard, *American Nervousness.*

Heart, lungs, and kidneys owe their development and present power to the demands and stimuli of the muscular system; and these stimuli greatly increase the efficiency of our digestive and assimilative tissues. It was sensation and motion, not thought or learning, which laid the foundations of the brain, and stimulated the development of all its centres. Our internal organs can and will respond to all reasonable demands of our muscular system. It is an inherited habit. They require these customary motor stimuli to maintain them in their best condition. Without them, as in sedentary life, they degenerate, and invite, if they do not produce, disease.

The death-rate does not rise proportionally to the increase of morbidity. Neurasthenics are exceedingly cautious and careful of themselves. They generally exist through a long period of invalidism. The case of the nervous dyspeptic is similar in a less degree. But it is not the kind of long life which we desire for ourselves or for our children.

A second fact demands our careful consideration. The higher we ascend in the social scale, the greater is the sensitiveness to pain. What is actually painful to the professional man is hardly more than disagreeable to the laborer. Rosenbach and other good physiologists maintain that this sensitiveness is increased, if it may not be caused, by lack of motor exercise. This hypersensitiveness tends to produce timidity and hesitation, and is a most important causal factor in hysteria and similar weaknesses, as well as a symptom and result of the lower tone of vitality throughout the body. A good physiologist has well said: "Health comes in through the muscles, and flies out through the nerves."

It is universally admitted, I believe, that sedentary, indoor life, especially if accompanied by excessive mental labor, acting upon any except the very strongest nervous system is likely to result in general weakness, probably manifesting itself largely through the nervous system; and that the cure for this condition is to be sought in rest, open air and sunshine, in muscular exercise suited to the patient's powers, and in escape from the worry which is at once symptom and worst cause of over-fatigue. We have thus far noticed a few of the results of modern changes in conditions and habits of life in males. That similar causes have resulted in similar, perhaps more marked, effects upon the American woman, can hardly be doubted. The fathers and mothers have sinned, and too frequently the children's teeth are set on edge. They do not inherit disease directly, but they are born and grow up with a lower vitality and often with a morbid predisposition.

Two classes of children in our public schools to-day demand our special attention. First, the children of business and professional men. Some or many of these are congenitally liable to nervous weakness, or are suffering from low vitality. They must be guarded from, and strengthened against, their dangers. Second, the brighter, more promising, and more ambitious children of every class. Both these classes will probably enter mercantile or professional careers, and both must be fortified accordingly. They should furnish our legislators and leaders a few years hence. A tough body and a sound nervous system are absolutely essential to them both.

Muscular exercise and fresh air are absolutely necessary to the child to promote growth and development of all the vital organs, the brain included. If the motor centres are not well developed, the adult becomes an unpractical dreamer, ever, as President Walker has said, "standing shivering on the brink of action;" always planning, hoping, or criticising, never creating or realizing. The motor centres must be developed early, if at all.

The average child needs far more outdoor exercise to-day than a century ago. He actually has far less than used to be furnished by the farm. In the city he has very little, if any at all. We must not forget that the child begins going to school much younger, and that the school year is almost three times as long as then. We are already planning summer schools to keep him busy, and to take him off our hands, for the rest of the year.

But moral health and welfare is at least fully as important as physical. The great increase of wealth and its accumulation in the hands of a few are fraught with moral dangers to the state and to the citizen. I can find no record in history that any state has perished through poverty or hardship. But few states or individuals can long endure prosperity or luxury. It is very likely to breed flabbiness of tissue, if not rottenness of the bones. Prophets and seers of all ages have dreaded and denounced the accumulation of great wealth. We must recognize and face this danger, and gird our loins to meet it.

Wealth and physical comfort loom large before our eyes. We all see and reasonably desire the comfort or luxury enjoyed by the few. Everywhere we see the desire, if not the cold-blooded intent, to get something for nothing, to attain fame or fortune without giving an equivalent of honest work in return. The isolation which made our forefathers hunger for neighbors has given place to overcrowding, where each man must push and struggle for place and livelihood. Never have men planned more shrewdly or worked harder to get a living. Far less thought is given to living the life of the highest enjoyments and attainments. Idealism is at a heavy discount; the tangible and the eatable are the realities. Crude materialism is the practical philosophy and policy of too large a part of our population. Such conditions do not tend to produce men of great hearts and of broad sympathies. Yet "out of the heart are the issues of life." The invisible forms a very small part of our environment; yet it still remains true that "the things which are not seen are eternal." "Where there is no vision the people perish."

The opportunities are equally great. Men are awakening to the responsibilities of wealth and culture, power and knowledge. Never was charity more broad and active. Everywhere we see signs of a soul-hunger after something sure, true, and grand, which is almost pathetic. There is more religion in the world than ever before. Soon it will crystallize in new and fairer forms. Hopeful signs are tenfold more numerous and clear than discouraging symptoms.

In some way we must rear a race of men and women who can ward off the dangers and seize the limitless opportunities. They must be men and women of power, who can neither be bribed nor frightened, and who will be heard. Child-labor, defrauding of the poor, corruption and bribery, evils as great as slavery, are firmly intrenched, and defended by all the resources of wealth and influence. It is no easy task to dislodge them. Capable, wise, and strong leaders are needed to organize the overwhelming forces for good. We need men and women of knowledge, intelligence, patience, wisdom; of unwavering faith in the principles of "government of the people, by the people, and for the people;" of profound moral and religious convictions and loyalty. Above all, they must be "strong and of a very good courage." Such we must furnish.

Evidently our system of education must be continually modified to meet new conditions, if it is to train boys and girls to meet the emergencies and seize the opportunities of modern life. The ideal system is the one which best meets the vital problems of the present and the near future. One hundred years ago the school could rightly lay all its emphasis on books and learning. These the home could not supply. But home and farm could and did insure physical health and vigor, all kinds of manual training, ingenuity, perseverance, and efficiency. Now the school must furnish all these, as well as mental discipline and culture. Especially it must insure nervous strength, vigor, poise, and endurance. In one word, it must be an institution of power as well as of learning.

What are the sources of power and efficiency in the strong man or woman? How can we promote strength and power? Look at a great ocean liner plowing its way through the water. You see the captain and steersman and the officers, the mast with perhaps a sail to steady the ship. Go down into the furnace-room, and you will find grimy, half-naked men shoveling coal into the furnaces. These men do not dine in the saloon, or strut on deck; they drive the ship. The power is in the steam furnished by the combustion of the coal.

Similarly in our bodies the ultimate source of power is in the digestive system. This must furnish material for growth and fuel for our nervous and muscular cells. Every one of these is a microscopic engine and burns fuel. But the engine must have a powerful draft to bring in oxygen and to carry off smoke and other products of combustion. So the second essential of power is good lungs, large enough to give the blood all the oxygen which it can carry, and thoroughly to remove the carbon dioxide. The kidneys must also be vigorous and active to remove the nitrogenous waste. Otherwise all the organs will be clogged and poisoned. The heart must be large and strong to carry fuel and oxygen swiftly to the cells, and to remove their waste. And the whole organism must work economically without waste of energy.

In a badly constructed engine the draft is insufficient. The coal is only half-burned and it is impossible to get up steam. The steam is wasted by leakage, or is poorly applied so that its energy is very incompletely utilized. The cylinder was not properly planned, and the movements of the machinery are irregular and jerky. There is much friction, and the bearings heat. The engine is too large or too small for the furnace and boilers. Its parts are not properly proportioned. Only a small amount of energy is produced, and most of this is wasted. The engine is frequently or usually in the repair-shop. Many men and women are like such inefficient and uneconomical engines.

The energy must all be utilized, and wisely and economically expended. This is insured by a healthy, firm, and steady nervous system. The original and fundamental use of the nervous system is to insure that every sensory stimulus shall call forth a muscular response suited to meet the emergency. A fly alights on my face and tickles my skin. This stimulates an organ of feeling and excites a nerve centre. It sends a motor impulse to the muscles of hand and arm to drive the fly away. I see an apple, go to it, pick it, and eat it. I hear and smell an automobile, jump from the road, and escape with my life. The day's work is a series of muscular responses to sensory stimuli, nothing more nor less.

Hence it is of the utmost importance that the nervous system should rouse to action exactly and only those muscles which can do the needed work, should stimulate their action only so long and so far as will meet the emergency. Many of us waste every day enough energy to more than double our efficiency. We waste it in fret, hurry, and worry. We consume in one movement twice or thrice as much as is needed. All our muscles are tense, when nine tenths of them were better relaxed. Then there is the "hair-trigger" nervous system which continually calls for action when there is no need or emergency. No wonder that we accomplish little and still become very weary. The trained athlete is very economical in his expenditure of energy.

The character of our actions and of our life depends very largely upon the direction followed by the outgoing motor impulses. Three men were on the road, two Jews and a Samaritan. All three saw a poor Jew lying by the roadside. The light reflected from the poor fellow's body fell on the retinae of their eyes, and sent a wave of sensory impulses to the brain alike in all three. In all three motor impulses went out from the brain to the muscles. In the Samaritan these went to the arms mainly. He stooped and raised and tended the sufferer. In the Jews the motor impulses all went to the legs, and the cowards hustled off toward Jericho. A large part of education should consist in a proper training of the motor side of the brain, and of the proper use of the muscles. Thus far we have spoken of man almost as if he were a machine or an automaton. He is this and far more beside. It is the mental characters which have "raised him far above his humbler fellows." Our man of power is a man of strong and steady will and of firm purpose, from which he is not easily moved or dissuaded. He has a strong will because he feels deeply and intensely. We shall see later how great emphasis Nature lays on the heart.

The efficient man not only feels and wills powerfully, he sees things exactly as they are. This power is one of the characteristics of genius. He is a man of high ideals, in the possibility of whose realization he has boundless confidence and hope. He has faith in God and trust in man. Hence his courage is undaunted. Having formed the habit of seeing things as they are, he is wise in his recognition and selections of means and skillful in adapting and using them for the highest ends. He is continually learning by experience. Some of us are so afraid of making mistakes that we never dare to try an experiment. But experience is the best teacher.

All these powers, moral, intellectual, and physical, are highly developed and well balanced in our strong man. He is symmetrical. There is neither too much nor too little of many qualities. Such men are rare. Some power usually falls short of complete development, and its lack mars or ruins the whole. This is the man's weak spot, which always hampers him, and which sooner or later gives way and causes his collapse. Such large, well-grown, completely developed, symmetrical, strong men and women are precisely the ones needed as leaders to help us to meet our emergencies and to grasp our boundless and countless opportunities. Even if our system of education can fully realize this ideal in only a few instances, it must realize it as far as possible in all. Only thus can it discharge its duty of fitting the rising generation to beat the record made by our ancestors. Anything less means stagnation or degeneration.

Our problem, therefore, is how to develop men and women having all these essential elements of power well developed and well balanced in one individual. It is not an easy one. We must make full and wise use of every means at our disposal.

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Our present material progress and success are due largely to the fact that we have learned to form a partnership with Nature and her forces. Rivers turn our wheels, coal drives our engines and locomotives, electricity runs our errands and pulls our cars. A few gallons of oil or gasoline do the work of hundreds of men or horses without weariness. Have we ever carefully considered the possibility of making Nature our partner in the work of education? She will do a large part of the work for us if we will allow her. She will surely thwart us if we run counter to her laws. If we are to gain her aid and support we must discover and respect her laws of structure, growth, development, and life.

In our zeal for learning we have often forgotten that the scholar must first of all be a man. We have seen that a strong and efficient man is something more than a mere stuffed or even well-trained intellect. He is by no means a disembodied spirit. He is an exceedingly complex being of many organs.

We are dealing with children. The student of psychology lays out for us a system of training based on the working of the adult mind. It contains much of great value. But does the child's mind work like the adult's? Or must he act and think as a child? A very wise and learned committee lays out for our schools a curriculum which does not assign a single period in the week to physical training, nor mention any such branch. They seem to have regarded the child as a disembodied spirit, or in great haste to become one.

We do not ask the baby to solve problems in mathematics or philosophy. We expect and desire in him only the dawn of mind. We ask and pray that he will eat well, breathe well, sleep well, wriggle and cry more or less, keep healthy, and grow. This is his whole duty. Bodily growth is his business. For how many years is growth the chief business of the child? Is it his chief business throughout the primary and intermediate grades? If so, what and how much is the school doing to promote growth during these years?

Perhaps bodily growth is no business of the school, but of the home alone. Our strong man must have well-grown organs. Childhood is their period for growth.

Growth seems to be the business of the child both at home and at school. Certainly the school can and sometimes does hamper growth. It can promote it. If it can do so it certainly should. This is Nature's clear decision. If we will not accept her verdict, we may as well give up hope of her coöperation in the work of education at the very outset.

In the grammar grade is learning and mental discipline of chief importance to the girl, or is care of the body and physical exercise absolutely essential at this period? No one seems to know, and very few care. What would Nature say? If we disobey her laws, it will cost us a heavy penalty. "The plowing of the wicked is sin;" not because plowing is not excellent, but because it is allowed to crowd out a far more important duty. Are some of our educational experiments and efforts sin?

Every one of these questions is of vital importance. To how many of them can we give an intelligent answer? A man who knows little or nothing of hydraulics will not succeed very well in harnessing the river to his looms. Only the expert in electricity can plan or build a dynamo. If we cannot answer intelligently the simplest and most fundamental questions as to the laws of growth and development, how can we hope to frame a system of education which will produce strong men and women? If we disregard or disobey the laws, will not Nature thwart us in the one case just as surely and completely as in the other? Only as we know what a man is, and what a child is and is doing at every stage of his growth and development, can we hope to plan a system of education which will win the coöperation of Nature in our work.

Even our hasty and superficial analysis of the man of power has shown us that he is a very complex being. We need to know far more of him. The easiest and most feasible method of study is to attempt to trace his development as a species during his whole past history.

But some one will say: "Why go so far afield? What can the theory of evolution teach us concerning the education of children?"

If man is the result of a long process of evolution, some of his organs must be very old and some very young. The same will probably prove true of different parts of the same system. Some of our muscles are very old and some very young. The same is true of different parts of the brain. The oldest parts must be those which are essential to life, otherwise Nature would not have begun with them. The oldest are fundamental and basal; the others rest on these like a palace on its heavy and rough foundations. We must lay our foundations deep and strong. If organs arise successively, there ought to be a very close relation and interdependence between some of them. If at a certain stage one system has drawn or lifted all the other systems, that system was evidently the strategic point or key to the whole process of evolution at that stage. These facts are of great importance, if they have any bearing on the growth of the individual child.

They bear directly and vitally on the growth of the child. It is a law of evolution that the development of the individual is a brief recapitulation of the development of the species. The development of the species, phylogenesis, occupied ages; that of the individual, ontogenesis, is very brief. The recapitulation must be crude and incomplete, for Nature has made a short cut wherever she could in the development of the individual. The study of the evolution of the human species will give us a glimpse of the order of succession in which different systems or parts of systems mature sufficiently to respond to the stimuli of our training and exercise. It can show us what is fundamental, and what organ at each stage gives us the key to the whole process of development.

A large part of the history of the race is recapitulated before birth. We need to know a little about embryology. Here Nature has her own way to a large extent, and we may study certain laws of growth and development better than at any later time.

We are beginning to see the character and scope of our problem and of the method of its solution. First of all we must know what man is, for manhood is the far-off goal of all our pupils' development. Then we must discover just how a baby grows into manhood, and just what Nature would have us do for him at every age and stage. She has her own plan and system of education, and will not change it to suit our schemes and whims. When we have discovered her plan, we may well consider whether it is good and best, or whether it may be slightly modified and improved. We may not desire to try to improve it. Nature is no such blunderer as some of us seem to think.

When we have discovered the characteristics of every stage of childhood, we can attempt to frame a system of education suited at each stage to gain the coöperation of Nature, and thus to train men and women of growth and balance, of health, vigor, power, and efficiency. These are qualities to which Nature is always ready to bend all her efforts.

In the remaining chapters our question will be chiefly how we can insure the sound body and vigorous health. This is the foundation without which the higher qualities of mind and heart develop precariously or feebly, or fail to realize their possibilities. The basis of education is and must be physical.

CHAPTER II

MAN IN THE LIGHT OF EVOLUTION

We must be very brief in our review of man's evolution, and can glance at only those stages which are suited to throw light on his physical structure and development.

Animal life is reduced to its lowest terms in the Protozoa, in which all the vital functions are performed by one or a few cells. These cells represent the units of which all our tissues are composed. Far above the Protozoa stand the Cœlenterata, illustrated by hydras, sea-anemones, and jelly-fishes. The older naturalists called all these forms Zoöphytes, plant-animals. They represent a second stage or plane of life. In the simplest forms the body is a sack, whose cavity is the seat of digestion. Nervous and muscular tissues are very poorly developed. The animal has no special organs of respiration, excretion, or circulation. Everywhere in this stage we find two systems, and only two, sufficiently developed to be fairly effective; these are the digestive and the reproductive. They are absolutely essential to life. Digestion furnishes the material for growth and repair, and for fuel. After these needs have been supplied, the balance is devoted to reproduction. The reproductive system provides for the survival of the species.

Worms, of which our common earthworm is one of the higher forms, represent a third plane of life. Lower worms greatly increased the amount of muscular tissue, and attained the general plan of structure of the trunk of all higher forms of life. The muscles forming the outer wall of the body were used for locomotion.

The introduction of muscular locomotion and of a large amount of muscular tissue required and occasioned many changes in the body. Muscular tissue is like a steam engine in one respect. It gains the energy for its work by burning material brought to it by the blood. A furnace requires not only fuel, but an opening by which oxygen may enter and a pipe for the escape of the smoke and gases. Similarly the development of muscular locomotion stimulated the improvement of the digestive system to furnish its fuel. Special respiratory organs appeared to furnish the oxygen. Excretory tubules, the forerunners of our kidneys, developed to remove the nitrogenous waste. A system of blood-vessels soon followed to insure a constant and rapid distribution of food and oxygen, and to carry away from the cells the products of combustion and other waste material.

We must never forget that the development of the muscular system carried with it, or dragged after it, the development of our most important viscera: kidneys, lungs, heart, and blood-vessels, and, as we shall see later, of the brain itself. A good digestive system is essential to existence; a tough muscular system is essential to health. But a muscle contracts only in response to an impulse coming along a motor nerve-fibril from a central nerve-cell. Every added muscular fibre absolutely required a corresponding addition to the nervous system, which accordingly steadily increased in size and complexity. In any segmented worm, like the earthworm, which is composed of a long series of rings, or similar portions of the body, there is a ganglion or group of nerve-cells in every segment.

But the moving animal is continually coming into new situations, finding new conditions, sometimes favorable, sometimes dangerous. It must "sense" the situation, and act accordingly. Hence we find special sensory organs developing at the front end of the body for sight, smell, and taste. Delicate organs of feeling, later to be used for hearing, also appear. The highest worms possess all the organs of special sense which we have, but often in a very crude form.

The presence and work of these highest sense-organs powerfully stimulated the foremost ganglion, or nerve-centre. It had to do the work of a brain. The eye starts as an organ capable of distinguishing between light and darkness. When it had become eidoscopic, capable of forming images of external objects, the brain developed with great rapidity.

The more swiftly moving worm soon developed weapons of offense; teeth, etc. Two zoöphytes may compete with each other. But the strongest jelly-fishes could hardly fight, if they would. The zoöphytic era was one of comparative peace. But worms can harm one another. They or their immediate descendants began the battle which still rages. This again makes life vastly more complex. The animal must recognize its enemies. If it were correct to speak of motives among these lowest forms, we might say that new motives will soon appear. The zoöphyte could feel but one emotion, hunger. The lowest vertebrate fears and becomes angry. At least, he acts as if he had these feelings. The introduction of muscular locomotion raised life to a new plane far above that of the zoophyte. There is nothing vegetative about life now. We might, perhaps, call this third stage the animal plane.

But the worm, after all his attainments, had hardly begun to utilize the powers and possibilities of the muscular system. As soon as the body wall had attained a fair degree of development, a skeleton appeared. Mollusks developed an external protective shell, which impeded locomotion, and usually precluded higher development. The clam, safely ensconced in the mud, beyond the reach of discomfort and danger, is the logical goal of this experiment. Arthropoda, including crabs, spiders, etc., developed an external, mostly locomotive, skeleton, and finally culminated in insects.

But some swimming worm began to develop an internal locomotive skeleton, and finally the vertebrate attained a rod of cartilage, the notochord, which gave place to the vertebral column or backbone. This skeleton opened up new and great possibilities. Larger masses of muscles could be used in the trunk. Fins appeared in fish. The amphibians, now represented by frogs and salamanders, changed the fins into legs, became air-breathing, and emerged on land. Life in the air increased the amount of oxygen, and diminished the loss of heat. This increased the efficiency of every organ, notably that of the nervous system.

The legs of the more primitive amphibians, *e. g.*, the salamander, are weak, and cannot raise the body from the ground. But in reptiles, *e. g.*, lizards, and in mammals, they lengthen and strengthen. The animal no longer crawls or creeps, but runs. Finally the arboreal forms, lemurs and apes, developed the hand. Each new part gradually attained a freedom and range of movement of which the older and lower parts were incapable.

The human muscular system may almost be called stratified. Different parts are of very different age. Our trunk-muscles originated in worms; those of shoulder and thigh in fish; those of arm and leg in amphibia; the hand as such was developed by arboreal mammals. The central portions are older, the peripheral younger.[1] The old, central systems of muscles are heavy, stout, simple, incapable of very precise or fine movement. The new systems in the hand are complex, light, capable of a great variety of very precise movements. In any complex action, *e. g.*, picking up a pin from the floor, we begin as a rule with old central muscles, we finish with peripheral. The former may be called fundamental; the latter, accessory.

It would be interesting to notice how the increased use of the muscles and the larger demands for fuel left a continually decreasing balance for reproduction. Fewer and fewer young could be produced. Each one became of greater and greater value and importance. This was apparently the occasion of the change from oviparous to intra-uterine development. This and the long period of infancy led finally to family life, as Professor Fiske has shown in his "Destiny of Man." But this lies apart from our subject.

We must return to the development of the nervous system. Its use is evidently to insure that every sensory stimulus should result in a muscular or motor response suited to the emergency.[2] Life is really a series of responses to stimuli. The day's work is nothing else.

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[1] Mercier, *The Nervous System and the Mind*, p. 374.

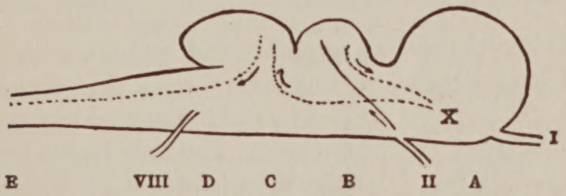
[2] James, *Psychology*, *Briefer Course*, p. 91.

Evidently the development of the nervous system has had its occasion and stimulus in that of the muscles and the sense-organs. The brain of a fish or reptile is surely not an organ of logical thought, nor has it been developed by logical thinking. It is mainly an organ for the control of locomotion. We find the occasion of the brain's complexity in the steadily increasing range and complexity of movement.

Motion in the earthworm is a comparatively simple matter. The animal lengthens and shortens, or writhes. Each segment contributes its part to the movement of the body under the control of its own centre or ganglion. The animal has neither eyes nor ears. The brain can stop or originate movement, or increase or decrease it. Here a very simple system suffices.

A shark is swimming through the water. The body is driven by sweeps of the tail drawn alternately right and left by contraction of the corresponding muscles. This movement is controlled immediately by centres in the rear part of the spinal marrow. But the animal is steered upward or downward by the fins. These must be held in the proper position, and this position may be changed suddenly or frequently. The whole body may have to be bent, the head raised or lowered. Let us suppose for the sake of simplicity that all of these changes result from impulses received from parts of the spinal marrow. Still these different movements must all be coördinated in time and degree. This demands a higher centre above all the lower ones. The cerebellum or small brain arises in response to this need or work. Walking demands the exact coördination of many muscles. Hence the cerebellum of man is very highly developed.

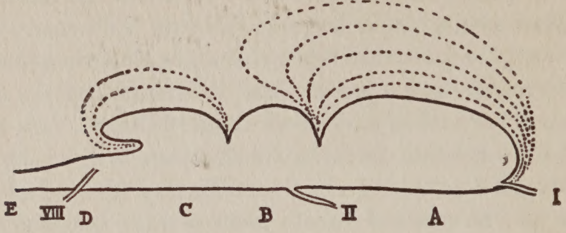
The shark hastens forward because it has seen its prey, or smelled it, or heard it fall into the water. The sense-organs have developed through greater use in connection with swifter locomotion. The nerves of the eyes originate or end in the top of the mid-brain. This portion of the brain owes its development to the sense of sight. The nerves of smell end farther forward at the base of the cerebral lobes; the nerves of hearing farther back in the medulla. We will suppose that the sight of the prey has attracted the shark. Impulses from the mid-brain must in some way reach and stimulate the cerebellum to coördinate the actions of the muscles to a movement in the right direction. The cerebellum is not in supreme command, so to speak, but must receive orders from a higher centre farther forward. The impulse may reach the cerebellum directly from the mid-brain, but far more probably through ganglia lying in the basal or lower portion of the cerebrum.



COURSE OF NERVOUS IMPULSES IN MOVING SHARK

Enters at *II* if Visual and goes to Roof of *B*. Returns to Basal Ganglia at *X*. (Or it may reach *X* from *I* or *VIII*.) Goes from *X* to Cerebellum *C*. Impulses from *C* control Centres in Spinal Cord.

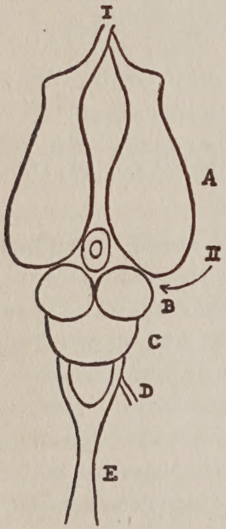
We here catch a glimpse of the hierarchy of centres in the nervous system, subordinated to one another like the officers of companies, regiments, brigades, etc., in a great army. The importance of this will become clear a little later.



BRAIN OF TURTLE

Showing increase of Parts in Higher Vertebrates by Dotted Lines. Medulla and Mid-brain increase little; Cerebellum increases much, and Cerebrum far more.

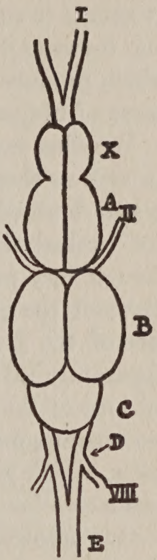
When the earlier amphibia and reptiles, with short and weak legs, crawled or walked upon the ground, the problem of locomotion was greatly changed. The body had to be supported by jointed legs. These had more muscles than the fins, and correspondingly greater freedom of movement. This occasioned a higher development of the whole series of motor nerve-centres. In these crawling animals the sense of smell became of great importance, and developed rapidly through greater use. According to Edinger, it stimulated in reptiles the development of a new portion of the brain, which was to gain precedence of and control over all the rest. This is the cerebral cortex.



BRAIN OF TURTLE
(From above.)

[1] James, *Psychology, Briefer Course*, p. 105.

The upper portion or roof of the cerebrum is composed in fish of a thin membrane containing no nerve-cells. But in reptiles such cells have appeared and have arranged themselves in several layers. The cortex appears at first to have been a seat of smell alone. But as the animal gained length of limb and swifter locomotion, especially as its dangers multiplied, sight and hearing were more and more used, and these powers and their centres improved rapidly. We find that in mammals every one of the higher senses reports finally to some portion of this same cortex: the eyes to the rear portion, the occipital lobe; the ears to small lateral portions low down on the temporal lobes. A better mode and higher stage of sense-perception is thus introduced. A lower mammal may very probably see with the mid-brain, but it perceives and recognizes with the cortex.



BRAIN OF FISH
(From above Diagram.)

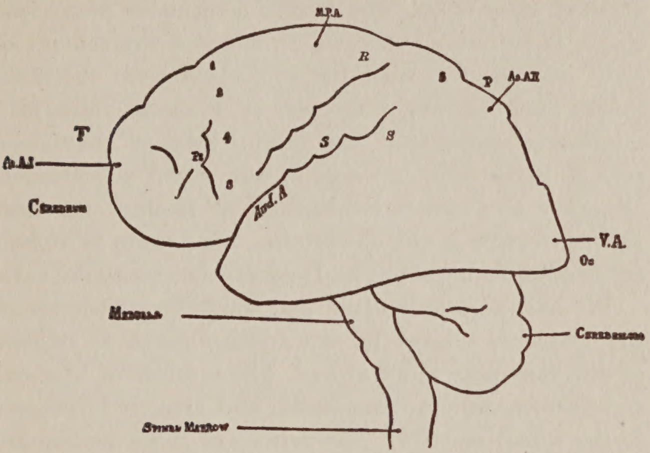
X = Capacity-Lobes.
A = Cerebrum.
B = Mid-brain.
C = Cerebellum.
D = Medulla.
E = Spinal Marrow.
I = Olfactory Nerves.
II = Optic Nerves.
VIII = Auditory Nerves.

We also find in the cortex the centres of ultimate control of all the voluntary movements of the muscles of the body. It has evidently become the seat of supreme command and control over all the older sensory and motor centres in the brain. The motor area occupies the parietal portion of the cortex, being nearly midway between its front and hind ends. In this area every great group of muscles, of face, trunk, arm, leg, etc., and their divisions, seems to have its own special portion. Good physiologists maintain that this area represents a projection map of the movements of all parts of the body. It stands to these in a relation comparable to that existing between the keyboard of a piano and the strings which produce the different notes. It has received the name of Meynert's area of projection.

Whether every group of muscles or movements has an area as sharply circumscribed as this would signify is still doubted by some or many. The area is probably not exclusively motor. It seems to stand in close, though very possibly indirect, connection with sensory fibres of the general sense of feeling for the whole surface of the body. We have much to learn. But it is apparently safe to conclude that this part of the parietal lobe of the cortex is the seat of control of voluntary movements, and that these are controlled from special areas, which may or may not be as distinct and localized as we have thought.

Our knowledge of the brain has been greatly increased by the study of diseases or injuries affecting limited portions of it. We may say in general that injuries affecting sensory centres or fibres result in insensibility of a corresponding part of the body, and that injuries to motor centres or fibres result in motor paralysis of certain muscles.

But there are areas of the cortex where localized injuries produce neither local insensibility nor local paralysis. Stimuli applied to these regions produce neither movement nor any sign of sensation. These portions have been called by some the silent areas of the cortex. There are two of them. One is the frontal lobe forming the anterior portion of the cortex; the other lies just behind the parietal motor area, Meynert's projection area; between it and the visual occipital area.



HUMAN BRAIN — LEFT ASPECT — DIAGRAM

F.	Frontal Lobe.	*V. A.*	Visual Area.
P.	Parietal Lobe.	*Aud. A.*	Auditory Area.
Oc.	Occipital Lobe.	*F2.*	Inferior Frontal Fissure.
As. A. I.	Anterior Association Area.	*R.*	Rolando's Fissure.
M. P. A.	Meynert's Projection Area.	*S.*	Sylvian Fissure.
As. A. II.	Posterior Association Area.		

Position of Centres of Movements in Monkey's Brain

1. Movements of Trunk.
2. Movements of Thigh and Leg.
3. Movements of Foot and Toes.
4. Movements of Arm.
5. Movements of Face.

These silent areas of the cortex are exciting much interest at present. They are very large in man, much smaller in the apes, smaller still in the carnivora, and scarcely recognizable in rodents. They are apparently the very youngest portions of the brain. We shall find that they mature very late in the development of the individual. Their main use seems to be to connect other areas or portions by means of their bundles of longer or shorter fibres.

Flechsig[1] has studied these areas more carefully, perhaps, than almost any one else, and has called them areas of association. The hinder association area, especially, is admirably situated to connect the centres of sight and hearing with the projection area. Flechsig thinks that this area is the seat of our most important intellectual processes. The frontal lobe or association area is in his view the seat of our moral perceptions. Whether so exact a localization of mental processes will prove true is still uncertain. That these two areas are seats of the higher mental processes seems almost sure.

We have already noticed that the different centres of the brain are related to one another much as officers of different rank in an army.[2] The muscles of legs and arms are controlled immediately and directly by centres in the spinal marrow. The actions of these centres are coördinated by the small brain. This, again, is controlled by centres in the cerebrum, whose headquarters are in the cortex. Similarly sensory impulses are received first by lower sensory centres, then transmitted, probably often somewhat modified, to result in clear perception when they reach the cortex.

The use of the nervous system is to insure a suitable muscular response to sensory stimuli. To reach the muscles and accomplish this result, sensory stimuli must be "switched off" on to motor nerves. The whole system of centres thus forms a great and very complex switch-board. The impulses may leap from the sensory to the motor nerves in lower or in higher centres. I rise and cross the room to get a book. The voluntary impulse to move goes out from the cortex to the cerebellum, and this centre controls my walk across the room. The higher centre is relieved from many or all details of the work, and my mind is free to think of something else at the time. In some or many reflex actions only the lowest centres in the spinal marrow are involved. I learn to walk, or ride a bicycle, or to write, with much effort and difficulty. The highest centres must give their attention to the work. Later I can make all the movements almost or quite without thought. The work once learned is carried on best by lower centres. It has been well said that the great aim of education is learning to do the right thing at the right time without having to think about it.

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[1] Flechsig, *Gehirn und Seele.*

[2] Mercier, *The Nervous System and the Mind*, p. 133.

The tendency of the lower centres is to respond to a stimulus by immediate muscular action. The mode of response is the result of our own habits or of those of our ancestors, and may be correct and suitable in a majority of cases. But we begin to suspect that some other response or reaction may meet the emergency better. We stop and think. One great use of the cerebrum is to restrain immediate response,[1] to allow the motor impulse to go out along a new path and result in a new action. Thus we experiment. Or it may not be best to respond at once. We must often wait moments, or perhaps years, until the time is ripe. Here is the great danger of the cortex. It may delay so as not to respond at all. So many outlets are open to so many muscles, resulting in so many different lines of action, that the impulse is dissipated. Many human brains are like sponges; they absorb sensory stimuli indefinitely, they discharge motor impulses only under much pressure.

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[1] Mercier, *The Nervous System and the Mind*, p. 145.

Certain results of our crude and hasty sketch are so important that we must notice them even at the risk of some repetition.

The human body is composed of many distinct systems and organs, all indissolubly united in one organism, where "every part is at once means and end to every other part." The health and life of the whole organism may be disturbed or destroyed by the weakness of any one of these numerous parts. What we often call the lower organs, the viscera, are absolutely essential to life, and hence by far the most important. They are fundamental as well as essential. Anything which disturbs our digestion or the removal of waste equally disturbs the clearness and vigor of our thought. Every part must be of the highest possible efficiency. One great aim of education should be to "make the weakest part as strong as the rest." If there is to be no schism in the body, the organs must be properly balanced in weight and power. Otherwise the overgrown part robs some other organ of its fair share of nutriment, and throws upon it burdens which it cannot bear. If any part is, for any reason, to be exposed to excessive strain, that part must be fortified and strengthened during its period of growth in early life. But every other part should be correspondingly strengthened to back it up in its emergency.

It is hardly possible that in so complex a being as man, all parts and organs should develop with equal rapidity at one and the same time. Evidently certain organs and powers which are apparently dormant in the infant are developing rapidly in childhood or youth. We should expect to find that there is a special time for the rapid development of each organ. We should naturally expect that the more fundamental organs, like digestion, excretion, and respiration, will develop early to meet the needs of other growing parts, and that some will be held back to give time and opportunity for this important process. In other words, there is a time for everything, and we must find that time.

We cannot fail to notice the immense amount of time devoted by Nature to the development of the muscular system. Why did she linger so long over it, before going on to the development of the brain, especially of the cortex with its mental powers? Evidently it must be of far greater importance, and have far larger latent capacities, than we have usually supposed. The muscular system is the strategic centre, so to speak, from and through which we can reach, exercise, and strengthen intestine, lungs, kidneys, and all the organs essential to life, but which are beyond the direct control of the will. Hence the sturdy vigor of our ancestors, and the dangers of a sedentary life.

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But the muscular system is the key to the development of the brain, as well as of lower organs. Nervous development followed the increase of locomotion and increased use of the sense-organs, especially of the eyes. Arboreal life and the use of the hand were exceedingly important factors in the development of the cortex. If this be true of the development of the species, it is probably equally true of the individual. Physical exercise and manual training, nature-study and other forms of observation, may develop intellectual power and keenness in the end more effectively than reading and spelling. This view is supported by the fact that the association centres — apparently the seat of thought — link together the sensory and motor regions of the cortex. We can consider this question more fully when we study the growth and development of the brain in the individual.

We have found that different portions of our muscular system have arisen at different ages, and that they grow younger as we go out from the trunk to the ends of the fingers and downward to the toes. The central and fundamental are older than the peripheral and accessory.

But each group of muscles, of trunk, shoulder, upper or lower arm, or leg, has its own centres of control. The fundamental muscles of trunk, shoulder, and thigh are capable of few movements, and these neither complex nor precise. The muscles of the hand, and especially of the fingers, are capable of a great variety of combination of movements. Hence it is to be expected—and this seems to be supported by the facts of anatomy—that the centres controlling the fundamental muscles would be comparatively simple, composed of relatively few cells with simple combinations. These cells must be large and strong, for they stimulate heavy masses of large fibres. Centres controlling the accessory muscles of hand and fingers must be composed of a very large number of cells. These must be able to combine in a great variety of ways, corresponding to the variety of hand and finger movements; hence the centre is very complex. The cells stimulate small and fine muscles; hence they will be correspondingly small and delicate. The fundamental centres, like their muscles, are older, tougher, and of greater endurance; the younger centres of the accessory muscles are not only more delicate, but weaker and more easily exhausted.

Therefore we are not surprised to find that the best physiologists insist upon the fullest possible development of these fundamental centres. They are the seats of endurance which enable us to hold out against the strain of modern life, especially in the hurry and fret of our great cities. They must be strengthened at all cost in the children of parents who show any signs or traces of nervous weakness, in all the children of the business and professional classes, and in those children who will later enter these lines of work. The high-strung American girl needs this preventive and developing treatment more than any other form or kind of education. No child can have too much of it, and in every case it is far better to have full enough than too little.

In one word, if we would fortify the nervous system of the child so that it will not collapse in nervous prostration under the strain of modern life, we must encourage him to use the heavy muscles of trunk, legs, and shoulders. He must run, jump, throw ball, and tussle with his mates. We shall find reason to believe that the most profitable period for this exercise is when the child is in the kindergarten or lower school grades.[1] Charts I and II summarize some of the most important events of our study in this chapter.

Chart I gives us the succession in the development of organs. Column A gives us a brief series of stages which will suggest approximately, though not exactly, those through which our ancestors in all probability passed. Column B shows the most important feature of their progress at each stage. Column C shows what functions or organs were called into being or stimulated to a higher development by the leading function given

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[1] Hartwell, *Physical Training;* Report of Com. of Ed. U. S. 1903, i, 724; Report of Director of Physical Training, Boston, *School Doc.* no. 8, p. 40; Ross, *Diseases of the Nervous System.*

ANIMAL DEVELOPMENT

A	B	C	
STAGES.	DEVELOPMENT OF	RELATED FUNCTIONS OR ORGANS.	ILLUSTRATION
Protozoa	Cell		Amboea
Zoöphyte	Digestion. Reproduction		Hydra
Worms	Locomotion	Respiration. Excretion	Earthworms
		Circulation	Annelids
		(Spinal Marrow)	
	Sense-Organs	(Brain)	
Fish	Fins and Eyes	Cerebellum. Mid-brain	Sharks
Reptiles	Legs and Smell	" Cortex	Lizards
Lower Mammals	" " Senses	" Meynert's Area	Cat. Dog
Arboreal "	Hands " "	Cortex, esp. Association Areas	Apes
Man	Mental Powers	Association Areas	

CHART I

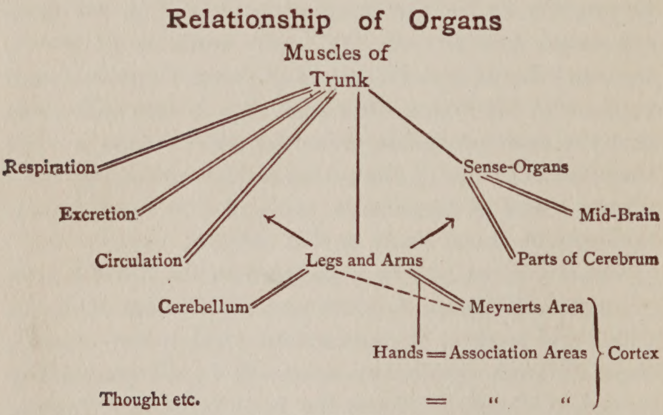

CHART II

in B. The protozoa developed the single cell or grouped these cells in colonies with no tissues or true organs. During the zoöphytic stage the digestive and reproductive organs were started. Worms introduced muscular locomotion. This step in advance was accompanied by the development of the respiratory, excretory, and circulatory organs, represented in our bodies by lungs, kidneys, and heart and blood-vessels.

Swifter locomotion called forth the higher sense-organs, which reacted on the foremost ganglion of the body, and stimulated its development into a brain. At the same time the muscles were doing a similar work toward the development of a spinal marrow, though brain and spinal marrow do not actually appear until the time of vertebrates. The development of the appendages called out the cerebellum ; and their higher use in mammals developed Meynert's projection area in the cortex, which had arisen in consequence of the greater use of the sense of smell. The cortex develops steadily through mammals. The association areas become large in arboreal mammals, and culminate as the mental centres of man

But the succession in origin of these different parts or systems is not as important to us as their mutual relationships. These, beginning with the appearance of muscles, are shown in Chart II. The organs fall into small groups, whose members are very closely related to each other. A close physiological relationship is shown in the chart by a double line. Digestion and reproduction developed side by side, and are closely related in that the amount devoted to reproduction is determined to a large extent by the amount of nutriment furnished by the digestive organs. The development of the heavy fundamental muscles necessitated and stimulated the development of our vital organs : heart, lungs, and kidneys. These form a closely related group.

Muscular exercise is still necessary for the development and maintenance of these organs in the individual man or child. They respond to muscular stimuli as they never do to those of the brain. An hour's brisk walk in the cool air arouses them all; but an hour's hard mental work has very small effect upon them.

Indirectly muscular locomotion favored the development of sense-organs. The cerebellum arose with the development of the appendages, and the mid-brain and certain areas of the cortex with the use of the higher senses. Here we have two partnerships developing side by side. The use of the legs and of the sense-organs is still essential to the development of these portions of the brain in every individual. We find it universally true that organs which arose at the same time, and either mutually dependent or one depending upon the other, always retain the original relation or dependence, at least for their healthy development in the individual.

Have we any reason to believe that the association areas, the special if not sole seats of the mental powers, are any exception to this rule? Their origin was stimulated by the development of the arms, and more especially the hands, with the sense-organs. Their fibres connect sensory and motor areas. Is not the exercise and development of sense-organs and hands essential to their early growth and development, as heart and lungs require the stimuli of muscular exercise for their healthy growth? Can we afford to neglect these original and essential stimuli, and depend solely or largely upon the far younger and later mental stimuli to promote the early and essential growth of the substance and tissues of these centres?

What we call our brain has been builded by successive additions at very different periods of geological history. Medulla, cerebellum, mid-brain, and the basal ganglia of the cerebrum, are old. They may all date from early palaeozoic time. The cortex is far younger, and its portions are of different ages. The association areas very probably did not arise until well on in tertiary or cenozoic time. They are still far from their final and complete stage.

Our brain is much like the fortress-palaces so common and striking in certain parts of France. Their foundations are old, heavy, and strong; capable of resisting anything except modern artillery. The successive additions grow steadily lighter, more complex, more graceful, and better fitted for a higher civilization.

So the old fundamental centres are the fortress-foundations of the brain, the seats of endurance and resistance. If they are neglected or incompletely developed, the whole brain structure totters or collapses. They, far more than the higher centres, claim and require our attention throughout childhood. In late childhood or adolescence we can develop the finer powers.

We see clearly that mental exercise of a logical sort has added only the finishing touches to the development of the brain. It originated as a switch-board between sensory stimuli and muscular movement. It is still a part of the great neuro-muscular system. Brain and muscle are never divorced in the action of healthy higher animals or of healthy men. They should not be divorced in the education of the child. God has joined them together; let not man by any artificial system put them asunder.

The intellect, especially the logical power, is the latest evolved function of the brain. Our system of education is in great danger of making it the spoiled child in the family of powers which make up the man. Emotion is older than thought; the heart than the head. If the individual recapitulates at all the development of the race, if the older powers are fundamental and essential, we should expect that feeling or emotion must play a most important rôle in human life, and that its proper exercise should form a correspondingly important part in every true system of education.

We have seen in our study of human evolution that parts and organs were added successively to very small and simple beginnings. The first organs to take form were those which were absolutely essential to life. The digestive system is the foundation of the whole body. Then masses of muscles appeared and were used for locomotion. Their rise was attended or soon followed by the development of respiratory, excretory, and circulatory organs. But the muscular system is very complex, and its parts are of very different ages. The muscles of the trunk are exceedingly old. Those of shoulder and thigh, of arm and leg, followed successively. Hand and fingers took their present form last of all. It was primarily the use of the heavy fundamental muscles which stimulated the growth and development of the internal vital organs.

Each addition to the muscular system was accompanied by the addition of new centres in the brain. The younger centres are far more complex and delicate than the older. The development of the hand stimulated the development of the higher intellectual centres in the brain.

The muscular system has thus been the key and dominating centre for the development of all the organs of the body from distant ages until man came upon the stage and the reign of muscle gave place to that of mind. We must not forget also the influence of the sense-organs in stimulating brain development.

The development of the child is crudely and imperfectly parallel to the evolution of the human species. Hence the essential vital organs are the first to become efficient. Their growth and development is aided by the exercise of the heavy muscles of trunk, legs, and arms. The exercise of these muscles stimulates also the growth and development of the fundamental nervous centres in the brain. This fortifies the nervous system against all forms of nervous weakness and collapse. Nervous prostration must be prevented by physical exercise in the kindergarten and lower grades. Here the foundations of power must be laid deep and strong. At this age strength is more important than grace or beauty.

The child during its earlier years should be educated far more through the muscles and sense-organs than directly through the brain. Hand and eye are now more efficient means of intellectual development than thought or even memory.

The young child is largely an animal. The higher mental powers which characterize man do not appear until about the period of puberty. Our chief aim should be to keep him a healthy animal, and to promote the growth of the fundamental organs and powers, which alone can form a firm and stable support for all later additions and improvements.

If we will bear these facts in mind, and recognize them in planning our system of education, we can have the aid and coöperation of Nature at every step. The old system of education on the farm was very largely such a natural system. The child was educated mainly through his muscles and his sense-organs. Such a system may seem to us very crude and incomplete. But with the coöperation of Nature it became marvelously effective. We must regain the coöperation of Nature, if our present system is to be nearly as successful and beneficent. We must in some way gain a clearer insight into her laws of growth and development. We shall hope to gain some knowledge of these by our study of embryology.

CHAPTER III

HINTS FROM EMBRYOLOGY

In this chapter we can notice but a very few of the most important facts of embryology, and these only in so far as they throw light on growth and education.

If you look at an egg dropped on toast or poached, you will notice a lighter spot on the yolk, about as big as the end of a small lead-pencil, which looks as if some one had blistered it with a hot iron. It is a disk like a watch-crystal, composed of a multitude of cells. Development in a fresh egg has already gone far beyond the stage of the single cell, of which every egg consists at first. This is an embryo chicken, without a single organ, and with hardly a tissue except the two distinct layers of which it consists.

Soon the embryo becomes elliptical or shield-shaped, and we find a rod running lengthwise through its middle line. This is the notochord, the beginning of the vertebrate skeleton. Just above and parallel to the notochord a tube appears, the beginning of brain and spinal marrow. We can gain a fair idea of the position of these two organs, if we thrust two hatpins through a griddle-cake parallel to its diameter and to each other.

Then two series of segments or blocks appear, one on each side of the notochord. From these two rows of blocks the vertebrae and muscles will later arise. The sides of the disk are tucked under, and meet, and unite beneath to form the tubular vertebrate body. Then legs and wings appear, looking for a time like short stubby flippers, in which joints and fingers and toes will arise later. Slowly and gradually the eye is built, the brain shaped, the face moulded. For some time the head is shaped much like that of a lizard. Until far on in embryonic life it is difficult or impossible to tell whether we are looking at the embryo of a bird or of a reptile.

How does the egg-cell ever find its way through this vast embryonic journey? How did it ever learn to shape and frame a skeleton, to string the muscles, and to spin the marvelous cobweb of nerves running to every part of the body, and connecting it with exactly the right point in the brain? It is a most marvelous fact that an egg hatches into a chicken. We know only that Nature under favorable conditions always brings a chicken, never anything else, out of a hen's egg; and that the chicken is usually healthy.

All this work is done within a shell. Nature seems to say: " Keep your clumsy fingers off. If you touch the thing, you 'll spoil it." And she is quite right. Here we cannot help her at all. Our interference would be disastrous.

But if we could watch the development of a chicken, we should be inclined to interfere more than once. At a certain stage of development slits appear looking like little buttonholes, and extending from the outer surface of the neck through to the pharynx or rear portion of the mouth. A single one of these will remain as our Eustachian tube. They evidently correspond to the gill-slits of a fish. Cartilaginous rods and branches of the aorta form between these.

All these structures and the general form of heart and brain, as also the arrangement of the great veins of the body, are at this stage almost exactly as in fish, not at all as in birds. We are inclined to think that Nature has lost her way completely. But she smooths over and closes the unnecessary gill-slits, remodels or removes the cartilaginous arches, reduces the number of branches of the aorta, and regains the line of development leading to the bird. The ease and careless abandon with which she works in forming embryos is positively refreshing. She seems to say: "Do not worry about a little thing like a few extra gill-slits and arteries. I can straighten that out easily enough. I have made millions of chickens, and they always come out right. Leave that to me."

Later she seems to lose her way again, and builds a lizard's tail on the rear end of the chicken. No chicken ever had such a tail with so many vertebrae. She shoves some of them forward into the pelvis, moulds the hindmost together into a solid mass, and makes a chicken's tail.

Nature usually attains her end, but she very frequently reaches it by a roundabout, and apparently aimless, course. She often seems to blunder. But we cannot stop her or guide her. She must have her own way, and she will probably come out right. We cannot help her much here.

If we are wise, we would not interfere, if we could. For when the individual fowl starts its existence as a single cell, and proceeds to develop into a bird, its most natural if not its only possible course is to follow in general the same line along which its ancestors plodded in their upward progress through the ages of biological history. The bird must pass through stages very similar, at least, to those of fish and reptile. Of earlier stages it may give but slight hints. It hurries as fast as it can, and avails itself of a short cut wherever this is possible. But some, especially of the later stages, persist with remarkable pertinacity and distinctness.

Sometimes young are born with anything but the adult form and structure, and a metamorphosis follows birth. The butterfly is born a caterpillar, and the beetle, a grub. Remember President Hall's illustration drawn from the tadpole. The tadpole has a long tail like that of a fish. When it has gained legs, it absorbs the tail and comes out a frog. You may hasten Nature by cutting off the tadpole's tail. You thus make a frog in a hurry. But you spoil a good tadpole, and you do not get a normal frog.

Provisional structures, gill-slits in birds, and tadpoles' tails are a sort of scaffolding by which the adult structure is to be builded. More than this, the provisional structure is often essential to stimulate the surrounding tissue to produce organs of great permanent value.

The embryonic notochord is going to disappear, but it seems necessary to stimulate the surrounding tissue to produce the backbone. Repress the one, and you will fail to gain the other. The gill-slits will disappear. But they may be necessary to stimulate the formation of branchial rods, out of which our jaws and hyoid bone are to develop. If the growth of the lower, temporary structure is hindered or prevented, the higher and permanent organ suffers correspondingly.

Where there is a metamorphosis, the ancestral and the provisional stages and structures are often even more distinct than in embryonic development. Nature's course is even more roundabout than before. But her care for the young does not cease at birth. For a longer or shorter time after birth you must allow her to have her own way, and to follow her own course.

What we have said of the embryonic development of the chick applies equally well to the human embryo. And the baby undergoes a metamorphosis just as really as does the tadpole. The child is no more a pocket edition of a man than a tadpole is a miniature frog. Nature must, and can, and will, finish the one as the other, in her own way. Here again unwise interference may work great and permanent harm. We rarely hesitate to trust Nature to finish tadpoles and chickens. We equally rarely allow her to have her own way with the child.

The child is naturally successively animal, anthropoid, half-barbarian, and then civilized. If, when Nature intends him to be an animal, we try to make a saint or a sage of him, we are acting about as wisely as when we try to make a frog by decaudating a tadpole. In both cases we work permanent harm with the very best intentions. If we regard the lower stage as useless or pernicious, if we try to repress or obliterate it, we are knocking out the rounds of the ladder up which, with Nature's assistance, the child is climbing to manhood. The barbarous stage is just as really a stimulus to the development of the strong adult as the notochord is the necessary stimulus to the formation of a backbone. In her own good time Nature will carry the child out of the lower stage, as she has brought him up to and into it.

Whatever may be true at a later stage, it would seem to be a fair deduction from facts that in training the young child we can only furnish natural conditions, and that then we must trust the rest to Nature. We can furnish stimuli, but the stimuli must be suited to the capacities and to the stage of development of the child. Above all, during these earlier years we must follow Nature with care and docility. We must not try to coerce, or hamper, or hurry her. Otherwise harm will surely result.

It is evident that such a being as man cannot be builded in a day. Provisional organs, structures, and habits must wax and wane. Systems must be fully developed, correlated, and adjusted, so that the lower will support the higher. Similarly in our nervous system the fundamental portions must have time and opportunity for growth and development. Incomplete development of the lower part means weakness or arrest of development in the higher.

First a low and rude instinct appears, suited to the plane of life. This gives rise to a habit. The habit arouses a new instinct, and this in turn a new habit. The maturing of a new system requires a readjustment of old habits and methods of life. All these changes must follow one another in proper order and sequence, if we are to have a healthy mental development. We are just beginning to discover that many childish instincts, which have been despised as useless or degrading, are essential to the attainment of a ripe, strong, adult manhood.[1]

We must be patient. The fish-like or reptilian stage of the chicken is not very promising; we must not expect a child in the tadpole stage to show the agility or precision of action of the adult. He is living in a different medium, in a world and age of his own. Let him conform to it for the present. Whenever the Bible speaks of the childhood of its great heroes and leaders, it usually says merely: "The child grew and waxed strong."

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[1] James, *Psychology*, *Briefer Course*, p. 402.

We have seen that the human body is an exceedingly complex structure. Many organs must originate, grow, develop, and be coördinated and adjusted in one body. We often forget or underestimate the importance of growth. If any organ is undersized it is a source of weakness in the body. This is evident of heart and lungs, but equally true of all organs. Bone and muscle must grow well in the child before they can be developed and hardened by the boy and girl. Failure to attain complete growth is as bad as arrest of development, or even worse. If in any way we could increase the growth of all our organs ten per cent, we should attain extraordinary power. A slight increase of strength of muscle or brain often or usually means great superiority in efficiency. Hence any knowledge of the laws of growth is of the greatest importance to the student of education.

Growth is evidently a slow process and demands time. The complexity of the human body is the explanation of the great length of childhood. Nature always hurries the development of the individual as much as she safely can. She takes a short cut wherever this is possible. It is neither wise nor safe to attempt to hurry her still more, and to crowd into childhood actions and processes which properly belong to youth. Something fundamental and essential will surely be crowded out.

Many organs must find time for growth. All do not mature at the same time. All are not growing with equal rapidity at the same time. The internal vital organs grow rapidly during embryonic life and infancy, and are relatively large and mature during childhood.

The muscles mature in the order of their origin; the fundamental first, the accessory later. Their periods of acceleration of growth are successive. Some parts of the brain grow and mature early, others later. Growth is usually successive and by parts. Nature accelerates the growth first of one organ or part and then of another. We cannot overestimate the importance of this fact. We cannot change the order of succession in growth.

An even more important fact is that we can do much to promote growth or to hamper it. Every organ passes through three stages in the course of its development. The first is a stage of pure growth. The organ or part is enlarging as rapidly as possible by the multiplication or growth of its cells. These contain large amounts of water. The substance of the tissue is still in the process of formation, or is being shaped and moulded. All the energy which the cells can possibly produce is needed for these formative processes. The tissue is so immature that it cannot perform the function which it will later discharge. At this stage exercise is unnecessary and injurious. The organ should be left to Nature. Growth is its whole business.

In the second stage growth is still of prime importance. But now exercise is essential, for without it growth declines or ceases. The exercise must be suited in kind, amount, and degree to the condition of the organ. We do not yet ask, How much can the organ do or bear without positive and evident injury? but, What and how much exercise will best promote healthy growth? The child runs and climbs trees. His muscles are doing a great deal of work. But we should never admit that this is an argument for child-labor. We know that that would surely dwarf and stunt him. The kind of exercise is as important as the amount.

In the third stage the organ is approaching maturity. It is receiving its finishing touches. Soon further change will be impossible. Now is the time for more severe training. The power of endurance of strain can gradually be increased. Much productive work may rightly be expected and required.

Evidently most of the organs of the infant and young child are attaining the second stage of development. But much of the muscular system and a still larger part of the brain are in the first. During childhood the different muscles and the sensory and motor centres of the brain successively pass through the second stage. But the highest centres of the brain have hardly emerged from the stage of pure growth.

How are we to know when an organ is ready for and requires exercise? We have seen that the brain is a whole hierarchy of centres, some maturing early, others very late. The same is true to a certain extent of the muscular system. Moreover, the change from one stage to another is gradual or imperceptible.

Here again Nature will give us clear and trustworthy suggestions, if we will only seek and heed them. When a child cries from hunger, it evidently needs food. When it has eaten enough of plain, simple food, the craving is stilled, and the hunger ceases. The appetite or craving is a clear and unmistakable symptom of the bodily condition and needs.

So with the cravings of the muscular system. We notice the restlessness of young children, and that they tire quickly. Their fundamental muscles require large amounts of exercise, but in small doses frequently repeated through the day. This craving is entirely reasonable and beneficent. We do not heed it as we should.

Similarly the sensory, motor, and mental centres in the brain crave exercise successively. These cravings of the higher centres appear in the form of the child's interests. Hence his succession of interests is just as really based on physiological conditions and laws as hunger or craving for muscular exercise.

We sometimes think that it makes little or no difference what a child is doing as long as he is kept busy. This is surely wrong. He ought at this age to be doing what Nature bids him do, what he does naturally. In other words, — pardon the repetition, — we must follow Nature's suggestions, and suit our exercises, whether physical or mental, to the cravings or interests of the child.

Perhaps the child is hungry to run, and we deem it better for him to sit still and try to think. We are attempting to exercise a centre in the brain which is in a stage of pure growth. The exercise does little or no good, it may do some or considerable harm. At the same time we are depriving the muscles of exercise which is absolutely essential to them. We neglect or fail to exercise the sensory and motor centres in the brain, and wonder that the development of the higher centres is not more complete and harmonious. We forget that the finer muscles and the higher nervous centres require for their own development the highest possible efficiency and exercise of the fundamental parts.

Hence precocity is to be feared and avoided, especially in children of business and professional men, and in our cities. It means that some essential stage of growth or development is being neglected or overleaped. It can result only in a defective or ill-balanced body or mind.

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As the child grows into youth, Nature looses one after another of the leading-strings by which she has held him in a narrow path or groove. Slowly and gradually she gives him the opportunity and trains him to judge and choose for himself. He cannot follow all the careers or grasp all the opportunities of life. He must select that which fits his own powers or aptitudes. He must not specialize so early as to narrow his mental development. But individual differences and preferences will become more and more marked. Now we can and should begin to tempt and draw him to share our very best interests and enthusiasms. We are no longer limited by his cravings or interests. We must train and prepare him for the independence which he will soon declare. If we follow Nature in childhood, she will bid the youth follow us.

We have found that development takes place according to an orderly sequence. The great systems do not arise in the embryo in the same order as in racial development. Notochord and brain, very young racially, arise first in the embryo. But when a system has once started, it repeats in general outline, imperfectly and with many short cuts or limitations, the racial development of the same organ. Even in the brain, the old, fundamental portions grow and mature before the younger and accessory. In the different systems and organs the individual recapitulates briefly and imperfectly the development of the race.

We have seen that growth is anything but uniform in different parts of the body at any one time. Every year of immature life is characterized by the rapid growth of some organs. Every organ has its time when suitable exercise is needed to promote or maintain further growth. Without this exercise, growth stagnates or halts, and development is incomplete or defective. Clouston seems to be entirely correct in his view that an incompletely developed organ is very likely to become a seat of disease during adult life, if not before. It must always be a weak spot in the organism. Hence we should grudge neither time nor effort to insure the full growth of the body, especially of the vital organs, whose growth is stimulated mainly by the exercise of the heavy muscles. We often forget or despise them, yet power, efficiency, and even life depend upon their healthy and vigorous action.

Our chief problem and business is to discover what organ craves and therefore needs exercise during each year of immature life, and then to satisfy these natural and healthy cravings by exercise suited to the child's needs. We have seen that refusal to satisfy the cravings of the restless child for physical exercise and bidding him sit still too long over his book rob the muscles of needed exercise and the vital organs of the necessary stimuli, with little or no profit to the brain. It also results in a deep-seated aversion to books and study.

A child's interests are evidently symptoms of a craving for needed exercise by some centre in the brain, just as much as restlessness is a symptom of need of movement. It follows that until the interest is manifest, that part of the brain is not sufficiently mature to profit by the exercise. To prescribe such exercise at this time hampers growth instead of promoting it. A study which demands the use and exercise of brain centres which are not sufficiently mature to manifest an interest or to profit by it necessarily becomes an object of aversion.

We may teach the child to read before any interest in books or reading has been aroused. He learns to hate books. We hurry him into arithmetic before he is mature enough to have any interest in it. He learns to dislike arithmetic. If we will commence every study one year before the child is mature enough to become interested in it, we can arouse in him a permanent aversion to every study in the course. A similar child beginning the same studies a year or two older may find every one of them interesting and profitable. Of course much depends upon the method of presentation of the study and the mode of approach to it. We have made no account of the fact that the more mature child, with no more perseverance or application, and with far less expenditure of energy, will learn and accomplish two or three times as much in one half of the time.

The forcing process, the crowding back of high school studies into the grammar grades, and grammar studies into intermediate or primary grades, is a very dangerous experiment. It is liable to have a similar result to that of Dr. Blimber's training of young Toots, who, "when he had whiskers, left off having brains."

Home education would be much more successful, if parents had more trust in God and Nature, and less fear of neighbors and friends. The child must always wear nice clothes and appear well. Young children must be little gentlemen and ladies as soon as they can toddle. This is exactly what Nature would not have. Childish instincts and habits appear to us rude and unconventional, and they probably are so. We suppress them at once. It is not necessary or best that the child should always have his own way. But he should always have a child's and not an adult's ways. It is not best to unnecessarily thwart and hamper him. We worry about the child, and then worry and fret him into irritability and distrust of us and himself. We would fain obliterate or prevent all "tadpole" stages in development. A healthy, natural growth is impossible under such conditions. Thwarting and hampering a child at every turn is like cutting off every embryonic growth or organ which does not immediately assume the perfect form. Would it not be better sometimes to give the child the benefit of the doubt, to leave him to himself now and then, and see what he would do under such strange conditions? Is it not wise to watch and consider an instinct before we hasten to suppress it, not to find fault with good in the making, or unconventional behavior, entirely natural at a certain stage, which will surely change or pass away with greater maturity? Nature, which watched over the making of the child, may be trusted to lead him by her own devious and roundabout paths to a good and sturdy manhood. She has had far more experience than we.

CHAPTER IV

GROWTH IN WEIGHT AND HEIGHT

THE object of education is fullness of life, health, vigor, joy, and efficiency. This demands the largest growth and fullest development of all parts of the body, and their coördination in one symmetrical, well-balanced organism. This growth and development must include all our powers; physical, mental, moral, and religious. Of all these physical health is fundamental.

Nature tends to produce normal and healthy men and women. Ill health or weakness is usually the result of abnormal, artificial habits and conditions of life, either of ourselves or of our ancestors. The human body is an exceedingly complex structure. A multitude of organs or parts must have time and opportunity for growth. Every part has its own time for acceleration of growth. Care, attention, and proper exercise will at this time produce far greater and better results than before or afterward.

During infancy and childhood, at least, we must let Nature have her own way, and heed her suggestions. "First the blade, then the ear, then the full corn in the ear" is the law of a safe and sure development. Intellectual growth will come in its own time, and in fuller tide, because the necessary preparation has been made. The first need of the child is a well-grown body with healthy organs. Our first study therefore must be that of increase in weight, height, and chest-girth. For these are the best criteria of health and vigor.

The average weight of the male college student is between one hundred and thirty-five and one hundred and forty pounds.[1] Englishmen of the most favored class have about the same weight.[2] We wish to trace the rhythms of growth by which this weight is attained. Prenatal growth is marvelously rapid. Between the ages of three and four months the embryo increases in weight more than fivefold. During the first six months after birth the baby doubles its weight. During the first year the gain is almost one hundred and seventy-five per cent. From the third to the fifth year it is about fifteen per cent. In the sixth year it has fallen to about ten per cent. It remains near this mark with minor fluctuations for several years.[3]

In the eleventh year, more rarely in the tenth or twelfth, of the boy's life, growth in weight has declined to a minimum. In the thirteenth year, more rarely in the twelfth, a marked acceleration begins, and lasts about four years. In Northern Europe the period of acceleration begins and closes about a year later. The American boy is somewhat precocious.

Growth in weight of females. The average weight of the students at our Eastern colleges for women is about one hundred and twenty pounds.[4] The average for Western colleges seems to be somewhat less. English and Swedish women of the same age seem to be from two to four pounds heavier.

Growth in weight during the first six or seven years of the girl's life is practically the same as in the boy, though she is usually a little lighter. Growth usually falls to a minimum at ten. Her period of acceleration covers the twelfth to the fourteenth years. The decline in the fifteenth year is sometimes abrupt, sometimes gradual. In most cases growth is slight in the seventeenth year, and has practically ceased in the eighteenth. The gain after the eighteenth year seems to be greater in Europe than in America. The girl is more precocious than the boy by one or two years. Hence from the twelfth to the fourteenth year she usually weighs more than he. Her period of accelerated growth is shorter.

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[1] Hitchcock and Phillips, *Physical Growth of Students during Course at Amherst College.*

[2] Roberts, *Manual of Anthropometry*, p. 78.

[3] Holt, *Diseases of Infancy*, p. 20.

[4] Hitchcock, *Comparative Anthropometry.*

Growth in height. The average height of the male student is about 68 inches.[1] Growth in height is very rapid during infancy and early childhood, and falls to a minimum at eleven or twelve. Acceleration begins at thirteen or fourteen, and lasts about four years. The average height of the college woman is about 63.5 inches.[2] The girl has a fairly steady and somewhat rapid increase in height up to about the fourteenth year. Her year of minimum growth is at ten or eleven, but the decline is not very great.

The normal *chest-girth* of the Eastern college student is about 35 inches.[3] But this varies considerably in different localities. Increase is very rapid during the first year,[4] declines until the fifth, rises in the sixth, is irregular until the acceleration at fourteen or fifteen. We have few measurements of chest-girth of girls. They seem to have a marked increase at eleven or twelve.

Growth in all dimensions is evidently very rapid during infancy and early childhood. There is frequently a retardation at about seven or eight, and a minimum at ten or eleven. Then comes the acceleration accompanying the pubertal changes. Height and weight, except during a part of the pubertal period, are rarely markedly accelerated at the same time. The same is true of annual growth. Fall is the time of rapid increase in weight, and spring and early summer of increase in height. Growth during winter is usually slow.[1]

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[1] Hitchcock, *Comparative Anthropometry.* [2] *Ibid.*

[3] Hitchcock and Phillips, *Physical Growth of Students.*

[4] Holt, *Diseases of Infancy*, p. 20.

But health and vigor do not depend upon great bulk or stature. The tallest and heaviest are often lacking in endurance. It is of far greater importance that the body be well proportioned. If height, weight, and chest-girth increase unequally, the proportions of the body must be different at different ages; and this difference will almost certainly affect the vigor of the child. Lean and full years, periods of strong and of weak resistance to disease, will alternate.

Up to the age of about fifteen the legs are growing much more rapidly than the trunk. During the first triennium the percentile annual increase of the trunk is two thirds of that of the legs; during the second a little more than one half; between six and nine less than one fourth; between twelve and fifteen less than one half. After fifteen the upper half of the body gains twenty-five per cent, the lower hardly one half as much.

In the adult male the sitting height is about fifty-three per cent of the standing height, but varies considerably. At birth sitting height is probably two thirds to three fourths of the length of the body; at five it is about fifty-six per cent; at fourteen or fifteen the ratio has fallen to about fifty-one per cent; at sixteen it begins to rise again. The legs seem to gain relatively rapidly at the periods of retardation of growth at eight and eleven, while at fourteen and fifteen the relative gain of the trunk is much improved.

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[1] Malling-Hansen, *Perioden in Gewicht der Kinder.*

The proportions of the girl undergo similar variations. Her trunk is usually somewhat larger relatively. The gain of the legs begins and ceases earlier.

Chest girth is at birth nearly two thirds of the height.[1] At nine it is almost exactly one half. The ratio diminishes until the thirteenth or fourteenth year in the boy. After this it rises continually, and at twenty should exceed one half the height. The ratio of depth to breadth of chest is very large at birth. During the first year depth very nearly equals breadth. In the girl of five the ratio has fallen to about seventy per cent; at fourteen it is sixty-three per cent; at twenty about sixty-eight per cent, or the same ratio as at the age of nine. The flatness or hollowness of the chest of the boy and girl at ten or eleven and its depth in the baby are apparent to every one.

The boy at twelve or thirteen, and the girl a year or two earlier, are farthest from the proportions of the infant. Adolescent and adult tend to return to the proportions of childhood. This is very clear in the relative length of trunk and legs, in girth of chest, and even more in its form and roundness. Even the old vegetative systems seem to gain a new revival of growth at adolescence.

Let us summarize the most important of our results.

Infancy and early childhood are periods of rapid increase in both height and weight. Growth declines steadily and sinks to a minimum at ten or eleven, with usually a less marked retardation at about eight. Increase of height until about thirteen or fourteen is due more to the lengthening of the legs; after fourteen or fifteen the trunk gains more rapidly. Increase in girth is much less rapid than in length until about fourteen. In the study of the child in the grammar grade we shall find that the short and small trunk with the relatively long legs is a source of weakness at this time. The vital organs in the trunk have not kept pace with the legs in their rate of growth. Hence we find in our study of morbidity that there is a steady rise in the amount of sickness throughout the period.

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[1] Holt, *Diseases of Infancy*.

It has been a subject of much discussion whether rapid growth is a symptom of increased or decreased endurance and resistance. The effect of growth on the physical vigor of the child depends upon its form and direction. Increased girth is always a sign of increased power. Increase of vigor and decrease of sickness is marked at fourteen and sixteen in the boy, and these years are marked by a rapid increase in girth. Increased length of trunk means more space for the vital organs, and hence increased health and vigor. Increased height must of course be accompanied by increase of weight. But if this increase is due mainly to additions to the length of the legs, it results in a heavy drain on the internal organs for material for growth and fuel, and for removal of waste. Hence between nine and fourteen, when the child seems to be largely legs with small and short trunk, especial care should be taken to provide abundant nourishing food and plenty of exercise in the open air, and a certain amount of leniency is necessary.

CHAPTER V

GROWTH OF THE NEURO-MUSCULAR SYSTEM

PLANTS and the lowest animals remain permanently on what we have called the zoöphytic plane of life. The truly animal plane is characterized by the development and use of the nervous and muscular systems. These have been termed animal in distinction from the vegetative organs of digestion, excretion, etc. They have been called the master tissues of the body. They are the means by which we react and conform to environment, grasping its opportunities and meeting its emergencies.

The relation between the muscular and nervous systems is exceedingly close. The two have developed together and hand in hand. Every change or current in the nervous system expresses itself through some change in the muscles; and every movement of our muscles reacts upon our nerve-centres. The two really form one great system, and it is only for the sake of convenience that we consider them separately.

In the average adult male the muscles form somewhat more than one third of the weight of the body.[1] In the new-born child they form about one fourth of the weight. Between birth and maturity they increase about thirty-seven fold. Until the fourth year of life the viscera are outgrowing the muscles, which apparently do not begin to increase very fast until the sixth or seventh year.

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[1] Vierordt, *Daten und Tabellen*, p. 29.

From this time until the age of sixteen or seventeen their relative increase is very rapid. During the first half of this period growth in length is more prominent; during the last half, growth in girth. After seventeen growth in weight usually slackens, but the muscles still increase in girth, toughen and harden, and gain greatly in strength and endurance.

At birth the muscles of the trunk are most advanced, those of the arms are in advance of those of the legs, but the latter grow more rapidly during childhood. As to increase of muscular girth we are still much in the dark. The following results seem to be tolerably trustworthy. The girth of the upper leg increases more rapidly during the first four years; after this the calf gains more rapidly. The same rule applies to the upper and lower arm. But the heavy muscles of upper leg and arm seem to have a second epoch of accelerated growth about the sixteenth year.

The movements of early childhood are mostly those of the whole member; and are produced mainly by the muscles of shoulder and thigh as well as of upper arm and leg. The arm grows less rapidly than the leg up to about the eighth or ninth year; afterwards the reverse is true. The running period is followed by one of greater use of the arms. The accelerations in increase of girth of arm and leg occur at fourteen and sixteen in the boy. But at ten the increase is more rapid than we usually suspect. There are apparently several alternations of rapid growth and comparative rest.

Strength of squeeze, or of grip of hand, increases markedly at six or seven, the gain decreases toward ten or eleven. The acceleration which we should expect at fourteen comes at different ages in different localities, probably according to the habits and conditions of life.

A muscular fibre of the same area of cross-section seems to have almost forty per cent more strength at ten than at eight, and to gain nearly the same amount between eleven and sixteen. Bryan's and Gilbert's [1] experiments on voluntary motor ability tested by rapidity of tapping on a telegraph key, showed a great gain at eight, usually preceded in Bryan's experiments by a similar though smaller gain at six. Gilbert tested fatigue also. The effect of fatigue usually decreases steadily from year to year, as the child's strength and endurance increase. But at eight the child fatigues more quickly than at seven. This rapid increase of efficiency, accompanied by quickness of fatigue, seems to point clearly to additions of new materials or other changes in the motor nerve-centres at this age.

The development of the muscular system of the girl is similar to that of the boy, but more precocious. In strength of squeeze her gain at seven and eight is very large. At or about ten there is a retardation. Acceleration begins at twelve or eleven, and continues about three years. Fatigue and efficiency both increase at eight, as in boys.

Growth of the Brain. According to Vierordt the brain forms 12.29 per cent of the weight of the body at birth; in the adult, 2.15 per cent. It is outgrown by other organs. Its absolute weight at birth is a little more than one fourth of its adult weight. It doubles its weight during the first eight or nine months, and trebles it by the end of the third year. At the end of the seventh year its weight is not very much less than at maturity. From this time on great increase in efficiency will be attained with but slight increase of weight. At birth the cerebellum has attained a considerably smaller part of its adult weight than the cerebrum, and during the last nine months of the first year its percentile gain is more than two and one half times as great. Between fourteen and twenty also its growth is rapid.[1]

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[1] Bryan, "Development of Motor Activity," *American Journal of Psychology*, v, 125.

Maturity, or more probably great increase of efficiency, is marked by the appearance of the medullary sheath surrounding the nerve-fibres in the centres. The first fibres in the cerebro-spinal system to become medullated are those connecting neighboring centres in the spinal cord.[2] These control the simplest reflex actions. Then follows the medullation of fibres connecting higher and lower centres in the cord. These are concerned in more complex reflexes. The medullation extends upward into the cerebellum, assuring simple coördinations. These changes are practically completed before birth.

At birth there is little medullation in the cerebrum. Here the sensory centres mature earliest; first, those of smell, then of sight, last of all, those of hearing. The centres in the cortex which preside over voluntary motion seem to mature later. The child is at first sensory and receptive; later an active, motor, purposing, and voluntary being.

Professor Donaldson has compared the mature portions of the child's brain to islands physiologically separated from one another. But the straits separating these physiological islands must be bridged or underlaid with cables before any real thinking can be done. The highest part of this work is probably performed by the association fibres of the cortex, whose centres seem to be seats of thought. These fibres are the last to become medullated. Many of them do not mature until adult life, some even after thirty. Hence the logical and other intellectual powers of the child are weak. It is during adolescence that the youth begins to appreciate and delight in argument.

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[1] Vierordt, *Daten und Tabellen*, pp. 19–24.

[2] Burk, "From Fundamental to Accessory," *Ped. Sem.* vi, 10.

Everywhere in the nervous system we find steadily increasing complexity. First come the simplest reflexes, then the more complex. The sensory centres mature separately, then the motor; then these become connected with one another. Thus the best and most efficient brain is not necessarily the largest and heaviest, but the one in which the largest possible number of the very best connections has been made in infancy and childhood.

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During its period of growth and of early development every organ is plastic and easily modified. Then these modifications set and become permanent. The brain forms no exception to this rule. There is a time when it is easy to learn to dance or to acquire manual dexterity. If we delay too long we acquire these accomplishments with difficulty, if at all. "It is hard to teach an old dog new tricks."

In exercising the nervous system to promote growth, or to train it to certain accomplishments, the exercise and training must be suited in kind and amount to the character of the centre and to its stage of development. Complex actions and processes cannot be expected from simple systems still lacking in coördination. The sensory centres must be trained early if at all. To neglect the developing motor centres in an attempt to exercise or train the still nascent association centres of intellectual power and work is poor economy ; and must result in waste if not in injury.

Nowhere do we find a clearer illustration of growth by parts in a regular and orderly succession than in our study of the nervous system. Nowhere do we see more clearly that the development of the higher centre or power depends upon suitable growth and development of the lower. The association fibres, with whose growth and development our higher intellectual powers seem to be coördinated, connect sensory and motor areas. Hence their development must depend upon the growth and development of the sensory and motor cells which they connect, and by whose exercise their growth is apparently stimulated.

We have already seen that the order of development of centres in the brain is, in general, first the sensory and then the motor. But if we accept this too literally and strictly, we shall fall into error. Infancy and early childhood are predominantly sensory, yet the baby learns to walk, and the young child runs. And sensory development persists into youth unless hampered or crowded out by an unwise system of education. It would be more correct to say that sensory and motor development react mutually. First come the simplest sensations and simplest movements, perhaps mere reflexes. The increased power of motion gives wider scope and better opportunity for new sensations, and these stimulate new motor activity. Every experience whets the appetite for new experiments, and these increase our stores of experience and knowledge.

This interdependence of powers and centres in the brain is probably not limited to its sensory and motor aspects. The highest centres react strongly upon our motor powers. We all notice the marked increase in the strength and efficiency of our muscles when we are stimulated by the hope of approval. The charging regiment hurls itself into the enemy's intrenchment with and by a cheer. Similarly the motor powers react upon the highest intellectual powers of the cortex.

This leads us to expect that the cortex will have not one period of accelerated growth, but several or many. Some fibres certainly become medullated far earlier than others. As to the growth and maturing of the association centres, we are still much or altogether in the dark. We may hope to gain some light upon this point by a study of the succession of interests of the child.[1]

We have seen that in every system a period of pure growth with little or no actual efficiency is followed by one when growth depends upon the stimulus of active exercise. So, when the muscles and nerve centres of the leg have reached a certain stage of development, the child begins to walk and then to run. This craving for exercise is a wise and beneficent instinct. Without it growth stagnates, and development is defective.

Similarly, the centres of the brain grow, and after a time crave exercise successively. We usually apply the word interests to the cravings of the higher centres, but these interests are as truly symptoms of the attainment of a certain stage of development and of real needs as the craving of the legs for exercise or the hunger of the body for food. The interests of the child may therefore furnish us a very valuable glimpse of the order of growth and development of the nervous centres and their powers. At the same time we must bear in mind that interests, like habits and instincts, are always modified more or less by surrounding conditions. We can expect that our deductions will be valid only in general, and that they can show us only what we may usually expect. Here again we must be prepared for great individual and local variation.

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[1] King, *Psychology of Child Development*, chaps. xi–xiv.

The first desire or interest of the child is to become acquainted with the objects which surround him. This characterizes the sensory period of life, lasting from early infancy to the sixth, or perhaps the eighth year. The young child wishes to handle everything. His eyes and ears are wide open. His usual question is: What is it? There is much in a name to him. But he is not merely enumerating and cataloguing objects and qualities. He is reacting to them, using them to satisfy his desires, to give him pleasure, and thus to awaken new desires. He discovers early what can be used most easily and effectively to make a loud noise or furnish some other gratification. We like to give things to a baby to see what he will do with them. He is really experimenting with himself and the world, which is wonderfully fresh and fascinating to him. He stores his mind with vivid and permanent impressions.

The original sensations and impressions are always strong; hence copies of these will frequently be reproduced by the mind, sometimes in strange combinations. In other words the child is very imaginative. It is said that a child under six years old believes everything which is told him. The impression is the great thing. Whether its occasion is real and objective or subjective and imaginary, he neither knows nor cares. All things are still possible to him.

The mind of the young child is apparently a picture-gallery of experiences, observations, and products of the imagination. The repetition, renewal, or recollection of these affords him keen enjoyment. The old story must always be repeated in exactly the same words to suit these mental images.

His nervous system is simple and normal. Sensory impulses find their way very directly to the muscles. The inhibitory influence of the cortical centres is still very slight or absent. But only the connections on the "lower levels"[1] are as yet thoroughly established. He must rely mainly on his heavy fundamental muscles. Early childhood is by no means a purely sensory epoch, but the motor powers lag behind the sensory. He cannot actually realize more than a small part of his mental images. Here again he uses his imagination to piece out his accomplishments. His toys are frequently hardly more than symbols. The chair becomes a horse, a car, or a boat; placed across a corner of the room it forms a house, a cave, or a wide field. Thus he plays himself into a knowledge of the world and of life.

The second period, lasting, according to Clouston,[2] from seven to thirteen, is one of coördination of motion and emotion. The sense-organs are still improving and craving exercise. But this is chiefly a motor epoch, when the child's greatest interest is in plays calling forth the use of the muscles of the legs and arms. The great importance of these plays can better be considered in a later chapter.

Our most important and difficult question is: When do the so-called higher mental powers begin to be sufficiently mature to crave exercise and thus make it profitable? The powers of logical inference certainly do not become prominent much before adolescence, and abstract reasoning is weak almost or quite until adult life. We notice the impulsiveness of the child. The sight of a running object tempts him to chase it almost as irresistibly as it would a kitten. We know that he will chase it. This immediateness and certainty of response characterizes control by lower centres. Other controlling influences are imitation and direct suggestion. Indirect suggestion is more potent with adults. These influences are very strong before puberty, and they are not characteristic of any marked rise in power of reasoning.

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[1] Burk, "Fundamental to Accessory," *Ped. Sem.* vi, 15.

[2] Clouston, *Neuroses of Development*, p. 12.

We should expect that one of the first signs of spontaneous intelligent comparison and thought about objects would appear in the arrangement of his collections. Mrs. C. F. Burk[1] finds little spontaneous classification by children. Quantity is of vastly greater importance. They merely keep and increase their collections until the age of nine, "when there is a small proportion of miscellaneous arrangements and of classifications according to color and size, with some few instances of a classification according to kind. But these classifications and arrangements appear mainly after eleven years of age." Taylor[2] found that few children of seven or eight years give any reasons for their hopes and ambitions, and that at nine the only reason given by many was: "I like it." Monroe[3] finds that few children of seven or eight give any reasons for their selection of favorite games, while after thirteen most of them give reasons for their choice. Says Monroe: "This would hint that thirteen years is the age when children begin to critically examine their evidence, and when the reasoning power of the mind appears as a dominant factor in the mental life of the child." Barnes and Shaw find the power to classify weak before twelve years. Hancock,[1] in a very interesting article on children's errors in arithmetic, concludes that their power to compare numbers does not develop to any great extent until twelve or thirteen. Mrs. Barnes,[2] in a study of the Historic Sense of children, found that at ten or twelve the number of inferences increased, and that the power of "legitimate inference" rose sharply at twelve. Burk also concludes that the higher mental powers begin to mature at puberty.

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[1] Burk, "Collecting Instinct," *Ped. Sem.* vii, 204.

[2] Taylor, "Children's Hopes," Report of N. Y. State Superintendent of Public Instruction, 1896, ii, 987.

[3] Monroe, "Play Interests of Children," *Trans. of Ill. Soc. for Child-Study*, iv, 5.

These views are supported by a large amount of evidence of great variety. If we accept them, it is evident that we often expect mental powers in the child other and higher than he really possesses. The child learns language mostly by imitation of parents and teachers, very little, if at all, by any understanding of rules of grammar. He imitates and acquires methods. He thinks, but he thinks as a child; largely in terms of movement and concrete action, not of rules or laws.

Hence courses of study, methods, and textbooks based upon systems of adult psychology are very likely to prove disappointing, when applied to the child. Indeed, the more closely they approach adult standards and ideals, the farther they are from the child's understanding and needs. The application of the results of child-study is so new that it must be more or less of an experiment. But it is an experiment of much hope and promise. The application of the results of purely adult psychology to the case of the child is almost surely doomed to failure. Such an experiment can have but one, and that an unsatisfactory, result.

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[1] Hancock, "Mental Differences," *N. E. A.*, 1897, p. 852.

[2] Barnes, *Studies in Education.*

CHAPTER VI

GROWTH OF THE VISCERAL ORGANS [1]

The Digestive System. According to Mühlmann the weight of the whole intestine in the male forms at birth 6.7 per cent of the total weight; from four to six, about 5 per cent; from fourteen to twenty-four, about 3.3 per cent. Relatively to the length of the body it is longest in infancy and early childhood. Beneke [2] tells us that it has from one hundred to one hundred and eighty cubic centimeters capacity for each kilogram of weight in the child, while in the adult the ratio is only about one half as favorable. During childhood it has to furnish material for growth as well as fuel for the fundamental muscles.

The Liver. In this organ most important changes of material, both constructive and destructive, are continually taking place. It is a sort of clearing-house for the business of the body. Hence its relative size is an important symptom of the amount of metabolism taking place at each period. It is relatively very large in infancy, and probably continues so during the first four years of life. It loses in relative weight at five, eight, and sixteen. This diminished relative weight may be due either to slow growth of the liver, or to the rapid growth of other organs. The loss at sixteen is almost certainly due largely to the latter cause, the loss at eight more probably to the former. But our figures after infancy are few, and their value is doubtful.

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[1] Hall, *Adolescence;* Virordt, *Daten und Tabellen;* Mühlmann, *Unsache des Alters.*

[2] Vierordt, *Daten und Tabellen,* p. 81.

The relative weight in the girl follows a somewhat different course. It is larger at birth than in the boy, does not diminish so rapidly during childhood, and remains higher in the adult. The differences between the sexes are too marked to be explained readily by the fewness of our observations. They are probably associated with the greater constructive, anabolic power and tendency of the female, as set forth by Geddes and Thompson.[1] The kidneys, which remove the nitrogenous waste of the body follow a very similar line of growth to that of the liver.

The Circulatory System. The heart at birth is relatively heavy. It doubles its weight during the first two years, doubles this at eight, and doubles this once more during the next six years. The relative weight of the heart, as compared with the weight of the body, is great at birth, sinks during the first year, rises at four, is low at eight, and rises again at about fourteen.

The volume of the heart doubles during the first two years. It somewhat more than doubles during the next five years. During the next seven years, between the ages of seven and fourteen, its increase is still slower, adding about two thirds of its volume at seven. During puberty the heart enlarges as much as during the preceding seven years. If puberty is attained quickly, as is frequently the case with the girl, the whole amount may be added during three or even two years. Hence during adolescence the heart is large but weak in both sexes.

The arteries are relatively large in childhood, smallest at puberty, after forty enlarge slowly, and in old age have nearly the same relative size calibre as in childhood. As the capacity of the heart increases at puberty much more rapidly than the calibre of the arteries, the blood-pressure rises rapidly at this epoch, while it is low in childhood and old age. The greatest activity of the organism coincides in time with the highest blood-pressure.

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[1] *Evolution of Sex*, London, 1894.

Both heart and arteries differ markedly in size in individuals of practically the same size and weight. Beneke found that children at birth may have hearts of hardly more than one half of the normal capacity. This condition may well be responsible for death from general weakness or from diseases of the respiratory system. Such children may survive with delicate constitutions. Or the weak and small heart may be strengthened and enlarged by proper exercise.

Beneke found also that death from typhoid fever was more frequent when the arteries were small and thus threw an excessive strain on the heart. Evidently difference in the size of the heart and arteries must affect greatly the whole life of different individuals, and of the same individual at different ages.

Growth of the lungs. The pulmonary or vital capacity of the average male college student seems to be between two hundred and thirty and two hundred and fifty cubic inches or about four liters.[1] Growth is very variable during childhood and youth according to conditions and habits of life. Increase is usually rapid in the boy between the ages of six and ten, but slackens during the next three years. There is nearly always a marked acceleration of growth at fourteen and again at sixteen. In the college woman the lung capacity is about two thirds of that of the college man.[1] There is usually little increase after sixteen. There is little difference between the sexes until the ninth or tenth year. In the boy the capacity doubles between ten and sixteen, in the girl the increase is far less, and usually irregular. The college woman has only about three fourths as much vital capacity for each pound of weight as the man. This may, or may not, be due to her constructive, anabolic physiological tendencies. Between five and ten the girl has nine tenths of the relative vital capacity of the boy. Between eleven and fourteen she usually falls behind rapidly. This is the period when she most needs a large supply of oxygen in the blood.

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[1] Hitchcock and Phillips, *Physical Growth of Students.*

During puberty, and probably before also, bright pupils have a constant and often marked superiority in this respect.[2] The importance of well-oxygenated blood for vigor and efficiency of the brain, as well as for general health, cannot be overestimated. Physical training has its good effects on the vital capacity of the boy as well as of the girl. The results are less marked in his case, because the boy usually manages to get a certain amount of outdoor play or other daily exercise which is frequently denied to the girl. It is doubtful whether even the boy has as large a vital capacity as he needs during puberty. Here the averages are probably somewhat or considerably below a true normal standard.

Metabolism in child and adult. We have seen that the human body may be compared to a steam engine. Coal is burned in the fire-box of the locomotive, oxygen is admitted or driven through the draft, and the waste products of combustion escape through the flues. The result of the combustion is heat, a part of which is utilized to furnish power. Similarly the income of our bodies is represented by our food and the oxygen absorbed in the lungs.

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[1] Hitchcock, *Comparative Anthropometry.*

[2] Gilbert, "Mental and Physical Development of School Children," *Studies from Yale Psy. Laboratory*, ii, 40.

In the adult a large part of the food is consumed in the muscles, some in the repair of the tissues, and the balance is devoted to reproduction. More or less may be stored temporarily as fat. During childhood and early youth the balance is devoted to growth, the formation of new cells or the enlargement or maturing of those already formed.

Our question is: How does the income of the child compare with that of the adult, and how is it used or expended?

Professor Atwater[1] has told us that the boy of fifteen or sixteen requires ninety per cent of the food ration of the adult man engaged in moderate muscular work; the girl of the same age requires about eighty per cent. Boys at twelve and girls at thirteen or fourteen require seventy per cent. The child from six to nine requires about fifty per cent. The young child between two and five averages about forty per cent. We may well remember that the girl at thirteen or fourteen weighs more than the boy of the same age and is changing faster. Probably she ought to digest as much as the boy of fifteen. In fact, she usually eats less than the boy of twelve. Here the observation probably shows us what is, rather than what ought to be.

We have already noticed the relatively large size of the intestine during infancy and early childhood. The demands for food during these early years are far greater than most of us suspect. The young child requires about twice as much food for each pound of weight as the adult. The infant needs even more. The infant and young child expend most of their income in growth, which is now very rapid. Comparatively little material is used as fuel by the muscles, probably even less by the nervous system.

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[1] Atwater, *Annual Report*, xv, 131.

As the baby and young child burn up less material for fuel, we should expect that they would require little oxygen and produce little waste. This is not the case. The infant seems to require fully one fourth as much oxygen as an adult weighing twenty times as much. Thus for each pound of weight it seems to require four or five times as much oxygen as the adult. Relatively to its weight it produces two or three times as much waste also, carbonic acid and urea. The boy of five or six produces twice as much heat for each pound of weight as the adult, the infant even more. Thus the amount of heat produced by each pound of tissue during the years of most active muscular exercise between fifteen and twenty is only about half as great as at five or six, or earlier, which are years characterized by sensory more than by muscular activity.

There seems to be but one natural explanation of the large amount of food and oxygen required, and of waste produced during infancy and childhood. Growth is a very expensive process, and demands the combustion of a large amount of nutriment, more than is consumed by active muscular exercise. Even opening flowers produce an appreciable amount of heat. Hence wise and generous provision should be made for a liberal supply of food and oxygen during periods of rapid growth or change. Kind and quality also demand attention. It must be suited to the needs of the epoch. The infant's food must be fluid and easily digestible. The child craves and needs much easily digestible fat, and usually wishes its bread buttered on both sides and on the edges, craves sugar and fruits, and is always thirsty. All these cravings, if not too immoderate, are entirely healthy. Over-indulgence is generally due to previous denial of a healthy craving.

Finally we should bear in mind that the digestive system, rather than the brain, is the foundation of all greatness. On it hang all the possibilities of health, vigor, and power, as well as of existence. A poorly nourished body can hardly contain or minister to a healthy brain. In early childhood the table and meal are far more important than school or books. Most of our diseases are due in last analysis to malnutrition or to lack of assimilative power. No energy without combustion, and no combustion without fuel, are as true of the human body as of the locomotive dragging the express train up the steep, long grade.

But the use of the material differs at different ages no less than the amount. In infancy, when the supply of food is relatively the largest, the smallest amount is burned in the muscular and nervous systems, and there is the largest balance remaining for growth. In early childhood a fair amount is used by the fundamental muscles, but the demands of the nervous system are relatively small. Growth is still the main business of life, and the use of the muscles is a means to this grand end.

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In later childhood and early youth, until twelve or thirteen in the girl, and a year or two later in the boy, the growth is more in length than in girth, and the legs are growing faster than the trunk. We shall find reason to believe that this growth in length and mostly in the appendages is an especially expensive and exhausting process. Adolescence is accompanied by a rapid increase in girth and weight, and during its later phase growth in height is mostly devoted to lengthening the trunk. This is quite another form of growth from increase in length of leg, and has a very different meaning and effect.

At sixteen or seventeen in the girl, and a few years later in the boy, growth has nearly ceased. Still very important changes are taking place in the body, consisting in the maturing, hardening, and toughening of the tissues. The endurance and power to resist unfavorable conditions are not yet great. During adolescence and a little later, the higher centres in the brain are maturing, and their expenses increase. Mental excitement is an even heavier drain on the resources of the body than muscular effort.

After maturity, when the tissues have become solidified, and the organs have settled into a permanent equilibrium, is the great time for productive work. Energy is abundant. It is used with economy, because the parts are in smooth working order, as well as because of practice and training. The male has a small balance to devote to reproduction. The female at, and for a time before, maturity economizes material. She takes in less oxygen, wastes less, and thus accumulates the store needed by the reproductive system.

The demands of the reproductive system decrease. The appetite and the assimilative power both decline after forty-five or fifty. Male and female differ less in their metabolism. There is still energy for much hard work, but it must be used with care and economy. In old age income and expenses are both small and constantly decreasing. Soon the weakest part gives way, and death ensues.

Thus the different body at different ages requires different kinds and amounts of nourishment, and uses its income for quite different purposes. Viewed as a machine for modifying the form and results of energy and material the child is a totally different being from the youth, and the youth differs greatly from the adult.

Our study of the neuro-muscular system showed us clearly that different parts of the same system grow and mature at different ages. In infancy and early childhood the trunk muscles are relatively heaviest. Then the legs grow, afterward the arms. The baby and young child walk and run; the older child climbs, tugs, and pulls, and exercises his arms. The fingers gain strength and precision of movement last of all.

In the brain the sensory centres are the first to grow rapidly and mature, then the different motor centres of legs, upper arm and forearm, wrist and hand, successively, but overlapping one another in their accelerations of growth. It is no small matter to develop and train so many muscles and motor centres properly. The sensory centres also need long practice and much careful exercise, if child and adult are to know the world exactly as it is. Only when these centres have been fully grown and properly developed can the higher mental centres in the brain reach their highest efficiency. Motor and sensory powers are the foundation on which all the higher mental and moral efficiency rest. The foundation must be laid deep and strong. We should not grudge time or pains for this essential part of the growth, development, and training of our men and women of power.

In infancy and early childhood the visceral organs are relatively large and heavy. The legs are short, the trunk long and nearly cylindrical. Nature is devoting her energy to the digestion and assimilation of the largest possible amount of food and to the removal of waste. Infancy is a period of almost vegetative life, and the same is true to quite an extent of early childhood. At the same time stomach, heart, lungs, and kidneys are stimulated by the use of the heavy muscles, and their healthy growth is insured. The small size and weight of the heart and the low blood-pressure favor growth rather than muscular or nervous efficiency.

Before eleven or twelve there are few really mental interests. The higher centres of the brain are not mature enough to crave much exercise. The child thinks; but must think as a child, not as a man. Nature will coöperate with us in the development of the sensory powers in infancy and early childhood. After five or six she bids us exercise the motor powers. She does not ask for athletics, but for sufficient suitable exercise to promote the healthy growth of the muscles and vital organs, and through these of the brain. She is now intent upon producing a well-grown and healthy body, the first and essential step toward the production of men and women of power and efficiency.

We shall see[1] that the average girl between ten and fifteen has only about three fourths, at most, of the lung capacity which she attains with suitable exercise. The lung capacity of the average boy during these years is probably somewhat or considerably below what it should and easily might be. Well oxygenated blood is absolutely essential to good digestion and assimilation, to removal of waste, to endurance of and success in work of any kind, and to resistance to disease. We have seen that bright children, certainly during these years and probably at all ages, have larger lung capacity than dull ones. The lung capacity is the best criterion of the health and vigor of the child.

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[1] See page 166.

It is evidently of the highest importance that we should increase the lung capacity of children in all the grades by abundant exercise in the open air. For the same reason the ventilation of our schoolrooms, especially for children of the lower grades, is of the utmost importance.

CHAPTER VII

MORTALITY AND MORBIDITY

WE study the rates of death and disease among children and youth to discover, if we can, what are their periods of weakness and of strength. It is of course of great importance that we should know just when the child has the least power of resistance, and needs the most care and more or less leniency in the tasks assigned to him.

We cannot study tables of death-rates without noticing that they are much higher in some countries and cities than in others. In some tables they are so low at certain ages as to be scarcely credible. But we may expect that differences in the methods of taking statistics or of making out tables would affect all ages somewhere nearly alike. The question which interests us most is not the absolute death-rate or the health of any particular city or country, but the relative rate at different ages.

All tables agree in certain general results. We notice first the exceedingly high death-rate of the first year of life. In both Boston and Germany twenty-five per cent or more of all children die during the first year. The high death-rate in Boston at this age need not surprise us, for we expect it in a city; though even here it is higher than is necessary. In Norway, a healthy country of farms and villages and of few cities, it rises hardly above ten per cent, even for boys. During the first three or four years the death-rate remains high, though declining rapidly. Between ten and fifteen very few children die. They have outlived the dangers of infancy and have not reached those of adult life. The minimum death-rate occurs, in Boston [1] and in Norway at twelve, in England at eleven, in Germany at large at thirteen, in Berlin at twelve or fourteen. The lowest death-rate among girls is, in Boston and in England at eleven, in Norway at twelve, and in Germany at large at thirteen, in Berlin at twelve, fourteen, and fifteen, during different years. The differences between the different ages between eleven and fourteen are usually slight. After this the death-rate rises somewhat slowly until about seventeen or eighteen, when there is frequently a somewhat sudden rise.

During the first two years of life far more boys die than girls. Between five and fifteen more girls die than boys, though the difference is usually not very marked in most countries, and may be explained by the supposition that the more severe selection in infancy has already weeded out the weakest among the boys. Between eighteen and twenty-one the death-rate is higher among the boys. After the thirtieth or thirty-fifth year the superior tenacity of life in the female is still more manifest; after sixty the preponderance of women becomes quite marked. Havelock Ellis [2] seems to prove that the constitutional vitality of the woman is greater at all ages, except in youth, than that of the male. This leads to the question whether her higher death-rate between fifteen and twenty, wherever this is the rule, is not due to wrong training or conditions of life, and whether it is not therefore avoidable.

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[1] Hartwell, Report of Director of Physical Training, Boston, *School Doc.* no. 8, p. 45.

[2] *Man and Woman*, London, 1894.

Are we justified in concluding that the years of lowest death-rate are those of greatest power of resistance to disease and of greatest health and vigor? Probably this is true to a certain extent. We often say that if a child or youth can be "tided over" certain years, he will probably outgrow his weakness. If there is any defect or disease in the organism, it will be more likely to produce fatal results at the time when the body is weakest. This probably explains a part of the death-rate between seventeen and twenty-one, and may explain certain irregularities at other ages. Acute and zymotic diseases might be expected to result fatally in a larger proportion of cases if occurring at years of reduced vigor.

But this is only one half of the truth. Natural death is never really sudden. It is only the sudden culmination of a disease which has been lurking and working in the system for a longer or shorter period. A girl of eighteen dies of consumption. This disease, if unchecked, would produce death after a certain number of years, whether the period was one of vigor or of weakness. The important question for us is not: When did the girl die? but, When did she contract the disease? For this age also was probably one of weakness. The earlier date is also the time when we can use the ounce of prevention which is worth more than the pound of cure. The age of death only sets a date when it is no longer possible to prevent the catastrophe. Hence, while tables of mortality are useful, they must be supplemented by tables of morbidity showing when the child or youth is most likely to show signs of decreased resisting power.

Such tables should show the prevalence of chronic diseases or disorders. Measles and diphtheria may attack even the healthy. But the period of the contagious and infectious diseases passes mostly with early childhood. Unhealthy conditions of the body, poverty of blood, loss of appetite, nervousness, headaches, sleeplessness, show a low tone of health and liability to infection, and warn us to be on our guard. I can find no such reports for America. But they have been prepared in Sweden, in Denmark, and in parts of Germany, and elsewhere. We may begin with the boys' schools in Denmark as studied by the Danish Commission in 1884.[1] We find that the boy enters school in comparatively good health, only 19 per cent showing chronic sickness or disorder. In the ninth year the amount of sickness has increased to 28 per cent, an increase of almost 50 per cent. The morbidity rises very slowly to 31 per cent in the thirteenth year. It then declines slightly until the sixteenth year. In the eighteenth year there is a sudden rise shown by the pupils of the gymnasia and Realschulen. In these schools the percentages of sickness are usually high. Hertel concludes that the high rate of morbidity in the academies and gymnasia is due largely to overpressure. The free city schools include the children of the poorest families living under unfavorable conditions, and these show a high rate of sickness. The children in the Realschulen and the peasants' sons seem to be the healthiest classes at the time of entering school. The lowest rate of sickness was in the orphanage at Copenhagen. These children are probably constitutionally weak, but are kept in comparatively good health by care and hygienic surroundings. This fact alone would suffice to prove that a large amount of the ill health is preventable.

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[1] Hertel, *Overpressure*.

According to the report of the Swedish Commission[1] the boys of the more favored classes in the city of Stockholm enter school in their eighth year in fair health. The rate of sickness is 17 per cent. In the ninth year, the second year of school, the rate has more than doubled and amounts to 36.7 per cent. There is a slight decrease in the tenth year, but in the eleventh the rate rises again to 40 per cent. These figures apply to the schools in the city of Stockholm alone, and here the rate is higher than elsewhere. In the common schools of Sweden the rate of sickness in the twelfth year is 34.4 per cent. It rises to a little over 37 per cent in the thirteenth year and touches 38 per cent in the fourteenth. It now declines. In the seventeenth year it is about 35 per cent in the Latin schools and 20 per cent in the Realschulen. In the nineteenth year in the Latin schools, and in the twentieth of the Realschulen, it rises almost or quite to 40 per cent. The rate of sickness is higher than in Denmark, partly because the examination was made in the autumn in Denmark and in the spring in Sweden. But in both countries it follows the same general course.

Key admits and emphasizes the responsibility of school life with its confinement and overpressure for the high rate of sickness among the pupils. But he argues, apparently with good reason, for the connection of the course of the curve of morbidity with pubertal development. The curve rises until thirteen or fourteen, which is the period of most rapid increase in height. As soon as the more rapid increase in weight begins, there is an increase in power of resistance, and the rate of morbidity sinks. When, about the seventeenth or eighteenth year, growth diminishes rapidly and soon ceases, the rate rises again rapidly to its second maximum. This view has found general, if not universal, acceptance. In this case the maxima and minima of sickness should appear earlier or later in different countries coincident with the hastening or delay of puberty. This also seems to be the fact. The general contour of the curve, with its maxima at about thirteen and eighteen or nineteen, and its minima at seven and sixteen, is fixed by the laws of growth, and hence the curves for different cities and countries will be similar.

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[1] Key, *Schulhygienische Untersuchungen*, pp. 21 and 134; Key, *Pubertätsentwickelung.*

But one country or city may have a higher rate of sickness at nearly all ages. Thus there is more sickness in Stockholm than in the smaller cities and towns of Sweden. Again, the maxima in one country are often higher than in another, as in Sweden compared with Denmark. So in different schools. In Denmark the academies had the highest rate, with the gymnasia next, and the Realschulen last. In such cases, when the boys come from similar stock and surroundings, and the examination is made at the same season and under similar conditions, it seems reasonable to explain the greater amount of sickness by the conditions of school life.

Dr. Schmid-Monnard[1] in Halle arrived at similar conclusions from the study of about four thousand children.

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[1] Schmid-Monnard, "Die Chronische Kränklichkeit," *Zeits. f. Schul.* x, 598, 666.

The boys entered the common schools with a very small rate of sickness, only 3 per cent. In the ninth year the sickness had risen to about 30 per cent. It sank during the tenth and eleventh, rose during the twelfth to almost 40 per cent, and then sank during the thirteenth and fourteenth years to under 20 per cent. His examination included no children in these schools after the fourteenth year.

The boys in the gymnasia and Realschulen close their first school year with a high rate of sickness, 21 per cent. Schmid-Monnard attributes this very largely to the change from freedom to confinement and to the work of the year. In the second school year the rate falls to about 14 per cent. In the ninth or tenth year the classes are divided, one set having school hours in the afternoon, the other not. Those without school hours in the afternoon have an average of about 25 per cent of sickness, with maxima in the fourteenth and seventeenth years of 30 per cent and 40 per cent respectively. The boys who have school hours in the afternoon have a markedly higher rate of sickness. Their maxima are, at thirteen and sixteen, 60 per cent to 70 per cent! The difference between the two sets is greatest at eighteen. The rate of sickness of those having afternoon hours is almost 60 per cent, while in those having the afternoons free it is less than 10 per cent. We may readily believe that those who are compelled to attend school in the afternoon are the slower, less efficient, and weaker, but granting all this, the figures show what can be accomplished by the forcing process with boys of this kind.

Many other European investigations of a similar character, which, however, give only the grades, but not the ages of the boys, could bė cited to prove that there is a gradual if not steady increase of sickness up to the twelfth or fourteenth year. This fact would seem to be established beyond controversy.

We may now notice the corresponding reports concerning the health of girls.

The Danish Commission reported concerning 11,646 girls of all ages. Of those in the sixth year (probably really the seventh, between six and seven), 25 per cent were sick. The percentage rises steadily to 43 per cent in the tenth year, and reaches its maximum, 51 per cent, in the thirteenth year. Then it declines to 40 per cent in the sixteenth year. The total average for all schools and ages was 41 per cent, compared with 29 per cent for the boys. But in the Jagerspris home the average of sickness between seven and fifteen was only 20 per cent. This shows the reduction in the amount of sickness which Dr. Vahl was able to attain by wise and careful treatment.

In Sweden the morbidity in the higher schools for girls was 28 per cent in the eighth year. In the ninth it rose to 50 per cent; in the tenth there was a slight improvement. After this the percentage rose steadily to its first maximum, 64.8 per cent (!) in the thirteenth year. There is, then, a somewhat irregular decline to 62 per cent in the seventeenth year followed by a rise to 68 per cent in the eighteenth year. In the nineteenth year the rate fell to 60.3 per cent. The Danish and Swedish curves of morbidity of girls follow very similar lines to those for the boys. But the rate of morbidity is higher in the girls, and their improvement during late adolescence is tardy and less marked.

Key's table for anæmia, a disease very prevalent among girls and characteristic of a low tone of vitality, is very instructive. Between the seventh and ninth years 15 to 18 per cent of the girls suffer from this disorder. The percentage rises to 39.7 per cent in the thirteenth year, changes but slightly during the fourteenth, sinks to 33.3 per cent in the fifteenth, and remains at about 40 per cent between the sixteenth and nineteenth years.

Schmid-Monnard found about 20 per cent of sickness among girls at the close of the first year of school, aged seven. In the tenth and eleventh years the percentage doubled (40 per cent). In the thirteenth year it rose to 50 per cent, and fell in the fourteenth year to 25 per cent. But in one of the higher schools for about five hundred girls, where, from the tenth to the fifteenth years, about 80 per cent did extra outside work, the percentage from the fourteenth to the sixteenth years was nearly 60.

Hertel found that at six the difference between the sexes was very slight. Between eleven and fourteen the percentage of sickness was:

	Anæmia.	Frequent Headaches.
Boys	8.3 per cent	2.4 per cent
Girls	22.0	8.3

Schmid-Monnard gives the following figures:

	Headache.	Nose-bleed.	Sleeplessness.
Boys	14.0 per cent or less.	6.0 per cent or less.	2.0 per cent or less
Girls	30.0	9.0	3.0

We should not pass by a statement of Dr. Crichton-Browne in his Introduction to Dr. Hertel's "Overpressure." He speaks of the prevalence of consumption in highly educated and cultivated young women. He says in substance: at all ages above thirty-five men die of consumption more frequently than women, and from twenty to thirty-five the numbers are almost equal in the two sexes. Between fifteen and twenty the death-rate from this disease is almost three times as high among females as among males. The disease has decreased lately far less in girls between five and fifteen than at other ages, or among boys. I can find no statistics for the same class of population in America, and do not know whether his figures would hold good here or not.

It would seem highly probable that the increased death-rate of girls at eighteen and thereabout from consumption and other diseases of relatively slow action is the culmination of an attack begun at thirteen or fourteen. If we are to diminish this death-rate, we must fortify the girl against the period of greatest weakness, when she is most likely to receive hospitably the germs of fatal diseases. To accomplish this we must not wait until the twelfth or thirteenth year, but meet the difficulty early in childhood. Much the same might be said of the invalidism which overtakes many of our women between twenty and thirty. The same might be said of the boy also, though his morbidity is not as high. We shall return to this subject again when we consider the period of puberty.

We may now attempt to draw from these investigations of conditions in Northern Europe conclusions applicable in America. There is a growing conviction among those best informed that there is great over-pressure in the schools of these countries, and that this is responsible for a good part of the sickness. No one can study the investigations without feeling that sickness increases in proportion to the hours of school and home work, and that it is inversely proportional to the amount of sleep and exercise. Is there overpressure in the average American school? and if so, how much? Here again statistics are lacking, and the answer is largely dependent upon individual opinion and observation. I cannot believe that the pressure in our American schools is generally as severe as in those of Northern Europe. But in this respect no two schools or classes are at all alike. The amount of time devoted to rest, physical exercise, and recreation varies extraordinarily. The home conditions of the pupils are not the same. One teacher is very severe, another very easy.

We have some very valuable studies of fatigue, and concerning the difficulty of mastering different subjects. Here again, however, we have to bear in mind that the amount of fatigue produced by a study varies greatly according to the method of teaching. Good temper, enthusiasm, and an even discipline in the teacher can make even a difficult subject easy and enjoyable. A mile's walk in a treadmill is far more exhausting than along a country road or through woods. A study introduced too early is very likely to cause fatigue and discouragement because it strains nascent powers and awakens little or no interest. The same study a year later might be easy and interesting. It would seem to be an easy matter for every school to obtain from parents a statement of the amount of time devoted to studies and to other duties, and of the number of hours spent in sleep and in outdoor exercise. The opinion of the family physician concerning the health of the pupil would also be invaluable. This is already done in most schools, and should be the rule of all. The important question is not, as so many seem to think: Do the demands of the school threaten seriously and evidently to injure the pupil? but, Are they suited in amount and kind to produce the best growth and development of all his powers? We wish to require what will thoroughly exercise and invigorate mind and body, not all that can be endured. These two standards and limits are quite different, and neither one of them has yet been clearly determined. Here is an exceedingly important problem, which still awaits solution.

However we may answer these questions, however high or low we may set the percentage of weakness or sickness in the different grades of different schools, certain facts are evidently clear. The amount of sickness tends to increase from about seven to thirteen or fourteen, and there is as a rule a marked rise about the eighth year, soon after the child enters school. The school may or may not be responsible for this rise in morbidity, but it should certainly mitigate and remedy it just so far as it possibly can. The period of rapid increase in height is always a period of comparative weakness, and demands attention, care, and some mercy. There is a second period of weakness or of decreased power of resistance at the close of growth, beginning usually about sixteen in the girl and somewhat later in the boy. However great our ignorance of many important questions, this much is clear, and it demands our most careful thought and consideration.

CHAPTER VIII

CONSTITUTION AND PERIODS OF LIFE

RATES of mortality and of morbidity are anything but constant in the life of the child. In infancy both are high; at six both are low; at about seventeen or eighteen both have risen; at thirteen mortality is at a minimum, and morbidity near its maximum. If either one or both of these rates give us any criterion of strength and vigor, it is clear that the health of the child is far from a constant quantity. Development is in all respects rhythmical. Periods of strength and of weakness alternate with each other, as do periods of acceleration and retardation in growth in height and weight.

Is it not true, therefore, in a certain sense, that the constitution of the child differs at different ages? Of course the constitution is originally inherited from the parents, and is strong or weak accordingly. As a rule the length of our lives is roughly proportional to that of our parents and ancestors. The importance of this fact is recognized by every life insurance company. Some families have a marked liability to certain diseases: gout, consumption, or typhoid fever; others are almost immune. The strong or slight reaction to drugs, poisons, stings, etc., is sometimes characteristic of all the members of a family.

But a good or bad constitution is not an inalienable endowment. The best constitution may be injured or weakened by excesses, and a bad constitution may be greatly improved. Probably a disease is never actually inherited, but only more or less of a liability or tendency to contract it. This tendency, if treated promptly, can be eradicated or greatly weakened.

We have all noticed that individuals and families differ greatly in stature, weight, and in size of bones and muscles. A man of light muscles and small strength cannot do the day's work of a strong man without considerable effort. Similarly individuals vary in the size, weight, and strength of their internal organs. Lung capacity is exceedingly variable. The capacity of the heart and the girth of the great arteries may be almost fifty per cent greater in one adult than in another of the same size and weight. The amount of blood probably differs very considerably in different individuals.

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A small heart can do the work normally required of a large one only under strain. If it has to pump the blood through smaller arteries, it must work against greater friction. If the burdens of life are heavy or the body has been weakened by disease, this strain upon the heart may have serious or fatal consequences. Beneke found that an unusually large proportion of those who died in an epidemic of typhoid fever had arteries below the average size.

The same or even greater variations in the size of the internal organs may occur in infancy. Hearts of hardly more than one third of the normal size have been found in the new-born. Such a child will probably die. If the heart is somewhat larger he may live, but he will probably have a weak constitution. Or the heart may be strengthened and enlarged by judicious exercise, and the constitutional weakness outgrown.

The same may be said of all the internal organs. The body is rarely made quite right in all respects. There is usually a weakest part somewhere, and one great opportunity and use of education is to make this weakest part just as strong as the rest. We have hardly begun to realize the importance and the possibilities of hygienic and preventive medicine. But the cure should be commenced as early as possible.

Evidently a strong and sound constitution requires a proper balance of organs. The income furnished by the digestive system and the lungs must equal the expenses caused by growth or by muscular or nervous exercise. The heart must be equal to its emergencies. Rapid growth or vigorous exercise demands a good circulation to bring material, fuel, and oxygen, to the tissues, and to remove their waste. If any organ is disproportionately small, it cannot do its share of the work. If it is too large, it either lacks proper and sufficient exercise, or it robs or strains the weaker parts of the body.

But the relative size and the balance of organs is not at all the same in the young child and in the adult. Roughly and approximately, between birth and maturity the muscles increase in weight about thirty-seven-fold; the lungs about eighteen-fold; liver, heart, and kidneys about twelve or thirteen-fold. The young child requires far more food and oxygen, and produces far more carbon dioxide, energy and waste for each pound of weight than the adult. In the baby the vegetative processes, digestion, assimilation, and growth, are most prominent; in the boy and girl, locomotion; in the adult, productive work.

If adults and children of different ages have different rates of mortality and morbidity, a different balance of organs, different relative incomes and modes of expenditure, in one word a quite different metabolism and habits, it is surely not too much to say that they have different constitutions and are leading different lives. They must be treated and trained quite differently. Inferences drawn from the life, habits, and needs of one age may not apply at all at another. What is beneficial to the adult may harm the child; and the reverse is equally true. It becomes of the utmost importance that we should be able to determine accurately the different periods in childhood and youth, and clearly recognize their characteristics. Otherwise our system of education, while entirely logical according to adult premises, and framed with the best intent and with great ingenuity, may do more harm than good.

It is urged that all our study of statistics can give us at best only a conception of the average child, and that the average child does not exist; that we are educating not average but actual children. This is quite true, and we do not sufficiently appreciate its importance. But if the argument is intended to prove that we may therefore neglect and disregard the difference between different periods of life, it becomes more amusing than convincing.

There is probably no such thing as an average case of typhoid fever or of mumps. The physician is treating an actual case of disease, not a statistical average. But the physician who diagnosed typhoid fever as mumps, and claimed that it made no difference, for there was nothing known to us through our experience which would exactly correspond to the case in hand, would hardly be considered wise. In all cases of any disease certain acts or indulgences, entirely permissible or beneficial during health, have to be avoided. The wise physician has a general idea as to what he may expect, and can do or may not do in each case, while he is alertly watching individual peculiarities, and prepared to meet unexpected complications.

We arrange our course of study for the average boy and girl. And yet they differ mentally even more than physically. We carefully modify the course of instruction and methods to suit the needs of the individual child whenever and in so far as we can. We claim for our physical study and training only that which is readily granted in the case of his mental education.

We must always allow the possibility of precocity and of retardation. The girl matures more rapidly than the boy. One boy of nine is more advanced in growth and development than another at ten or eleven. It is always better to take precautions too early rather than too late. We cannot fix the exact date when one period closes and the next begins. The transition is usually gradual. Yet certain inferences from our study of growth and its processes may still be made, and they may be entirely reliable. Some very real dangers may be seen and avoided, and some very general rules and suggestions safely deduced.

When we attempt to divide pre-adult life into natural periods, two stand out very sharply: infancy and adolescence. As President Hall has clearly shown, adolescence has been recognized as a most important epoch in all times and by all peoples. In savage tribes to-day the entrance of the boy into the rights and duties of manhood is solemnized by sacred and mysterious, often hard and severe if not cruel, rites and ceremonies. The wise Greeks and the Romans recognized the importance of the epoch. We err greatly in laying so little emphasis on the attainment of majority.

The parallelism between infancy and adolescence has often been noticed. "Every man is born twice; once at infancy, and again at adolescence." At birth the child enters the world, and begins his independent existence. But his independence is very small, his powers are limited. His development is along racial lines laid down by heredity. At adolescence he enters a new world of social and political life. He gains new powers and attains the independence and freedom foreshadowed at birth. Individual traits become prominent. He is preparing for his own special place and work in the world. He "girds himself and goes whither he will." Soon boy and girl will establish a family of their own. They stand on the threshold of a new world.

Each of the epochs is preceded by a period of preparation. The life or death of the infant depends upon his prenatal growth and development. Similarly the years of late childhood and of early puberty are a preparation for the new birth. The butterfly is born a caterpillar. After a period of growth it enters the cocoon. Here a thorough and profound metamorphosis takes place, and there emerges a butterfly "glittering with golden wings." Infancy and early childhood are hardly more than larval "caterpillar" stages. They more often mask than betray the most important characteristics of the adult. Puberty is a metamorphosis.

Each epoch is characterized by a rise in the death-rate. Nature guards her doorways with tests and examinations. The first one comes at birth. Is the child fit to live? Are all its essential vital organs sufficiently sound and strong to justify its entrance into the world? The baby passes the first examination with or without great credit, and stands the test of the diseases of childhood. Nature says, Go on.

Toward the end of adolescence the second great examination period begins, which will last far longer. Is the youth fitted to enter upon the duties and responsibilities of adult life? Can the boy and girl be of use in the world? Is it worth while to allow them to hand down their traits and characteristics to a new generation? Will they bequeath a sound constitution, red blood, tough muscles, steady nerves, strong character? Or have they squandered the grand estate which ought to have been preserved and improved for their descendants? Nature's entail is often broken. Physical defects, not discoverable in infancy, may have appeared. The metamorphosis may have been defective or utterly unsatisfactory. The youth dies.

But in infancy and adolescence Nature is patient. The weak child is "conditioned," as the schools say; but is allowed to go on. He may improve his opportunities and become strong. Or he may neglect the warning, and fail once more and finally. Some young men and women are conditioned; they have a period of invalidism at the close of growth. With proper care and persistent effort they may completely recover. But Nature has her eye upon them. To some of them the words of the prophet are literally applicable: "He may certainly recover; howbeit the Lord hath shewed me that he shall surely die."

Useless and weak men and women who have wasted their strength in the riot of work or play may survive and have children. Here the problem becomes more difficult and critical. But the children may often still be rescued. Behind the weak or prodigal parent there was a long line of sturdy ancestors, and the child may have inherited much or most from them. The case is by no means hopeless. But such children should be taken in hand early and carefully. They need care and attention, strengthening and toughening, if the family is to outlive their generation.

The completeness and success of the metamorphosis, and the character of its results, depend very largely upon the amount and kind of the preparation. The whole business of the larval stage is to store up material and strength against the crisis. The case of the human being is very similar. This gives an inestimable value to the otherwise somewhat prosaic and uninteresting years of later childhood.

Four quite distinct periods thus stand out sharply before us and claim our most careful study: Infancy, the period of pure growth; childhood, the period of preparation; puberty, the period of metamorphosis; adolescence, that of the rise of new powers and of entrance into a new world. Each of these periods might well be subdivided into shorter epochs, every one of which is characterized by progress in one or more particulars.

Our needs may be satisfied by a simpler, though entirely artificial, series of divisions. We may divide the life of the child and youth into six epochs of three years each. The first triennium may be called infancy in lack of any better name. The epoch between the ages of three and six may be designated as early childhood, or the kindergarten epoch. The years of later childhood between six and nine are passed in the earlier grades of school. The fourth and fifth triennia are passed in the grammar school or in the earlier years of the high school. They include the pubertal years, and one or more preceding and following. Between fifteen and eighteen we have to do with adolescents, though many of the characteristics of this epoch become more distinct at a slightly later date.

We must now attempt to reconstruct the child on the basis of our analytical study of the growth of the different organs. At each epoch we must discover, as far as possible, his constitution, using the word in its literal derivative sense. We wish to know the balance of organs. We must discover what organs are developing most rapidly and which will most profit by judicious exercise. Our question is: What is the very best use we can make of these years to promote the best and fullest growth and development?

If we can discover this much, we need not stop to question whether parent, teacher, superintendent, or the public should take the largest share of the responsibility; or where we will unload the blame for mistakes mostly of our own making. Each one of us can then proceed to do the best he can, every one in his own place and according to his own opportunities, without attempting to portion out praise or blame. Parents and teachers are, or ought to be, both sufficiently interested in the work.

We are to study mainly or altogether the physical characteristics of these epochs. The mental aspects of child-study, important as they are, lie outside of our field. But we may find that the physical conditions explain, if they do not determine, the mental habits and tendencies.

Whether our success in reconstructing the child at every one of these three-year periods be great or small, one fact is evident at the outset. The school is dealing with pupils in very different stages of development. The pupils of the grammar grades are entering upon the profound changes of the physical metamorphosis of puberty, when growth in height and morbidity will soon culminate. The higher mental powers are just awakening. The period is quite peculiar in its conditions and needs. These facts should greatly modify all our conceptions of and plans for education during the whole period.

During the later years of the high school course we are dealing with adolescents. Increase in girth and lung capacity have strengthened, freshened, and invigorated the whole body. The blood is hot and driven under high pressure. But the pupil has not yet passed the second culmination of morbidity which attends cessation of growth. The mental powers are fresh and keen, and interest in study should be intense.

During the primary and intermediate years we are dealing with children in the stage of preparation for the pubertal metamorphosis. They resemble adults about as closely as caterpillars resemble butterflies. Their chief business is to grow and to store up material and vitality. They have few intellectual interests. It is predominantly a motor period. Muscular exercise is essential to stimulate digestion, assimilation, and healthy growth.

The curriculum of each grade must be suited to the stage of development and needs of the child or youth. The needs of the pupils in these three stages are quite different. The curriculum, and the system and mode of education, must differ correspondingly. The immediate end and purpose of the work in each grade is peculiar and unique. What would be useful and beneficent in the high school may be harmful in the intermediate grade, and *vice versa.* In no one of these grades is the pupil like the adult. In the lower grades he differs so completely that we may easily fail altogether to understand his constitution, condition, and needs. The more the child differs from us, the greater is our difficulty in framing a course of exercise suited to his stage of growth or development. A good curriculum for the child in the primary grade will probably appear entirely childish and useless to the average adult mind. Until we recognize these facts we cannot hope to gain the coöperation of Nature in our efforts to develop strong and efficient men and women.

CHAPTER IX

THE FIRST THREE YEARS OF THE CHILD'S LIFE

THIS epoch is characterized by very rapid but steadily decreasing growth in weight and height. The new-born boy weighs at birth about 3½ kilos (7½ lbs.), the girl about 3¼ kilos (7¼ lbs.). The weight doubles during the first six months, and increases fourfold during the first three years.

The height of the boy and girl is about 20½ inches (52.5 cm.) at birth. It increases somewhat less than 50 per cent during the first year, and about 75 per cent during the first three years. The girth of chest is 34 centimeters (13.4 in.) or practically two thirds of the height. In the adult it is little more than one half of the height. The trunk is long, the neck very short, and the legs are small. The large trunk affords room for the internal organs, which at this time compose a very large portion of the weight of the body, and are furnishing the material for the rapid growth.

The girth of the head is at birth equal to or a little greater than that of the chest, 35 centimeters (13 to 14 in.). They remain practically equal for the first two years, but after this time the chest increases far more rapidly. The ratio of these dimensions is an important symptom of the vigor or weakness of the child. The girth of the chest at birth normally exceeds one half of the height by nine or ten centimeters (3½ to 4 in.). Frobelius has shown that mortality is greater among children having large heads and small chests. His results are given in the following table:

Class.	Chest girth exceeds one half height.	Head girth exceeds chest girth.	Mortality.
I.	9–10 cm.	Less than 2.5 cm.	21.0 %
II.	6.2 "	2.8–3.0 "	42.9 %
III.	5.0 "	4.7 "	67.5 %

In classes II and III the weight of the child is of great importance, lighter children showing a much greater mortality. Class III includes a much larger proportion of premature births.

The breadth across the shoulders should be about one fourth of the height. The forehead and cranium are very large, the face is small, the cavity of the mouth low. During this epoch the intestine and liver are relatively large; the heart is small compared with the diameter of the arteries, and hence the blood-pressure low. In the newborn child the pulse is rapid; over 130 to the minute according to Vierordt,[1] or almost twice as great as in the adult. The number of respirations per minute is over fifty during the first weeks,[2] and thirty-five to forty during the first three years. The adult breathes sixteen to eighteen times per minute. The brain is very large at birth and continues to increase rapidly during the whole epoch and the next.

The most noticeable and important characteristic of the baby is its small size. It has about one nineteenth of the weight and less than one third of the height of the adult. This means that the surface of the child is large compared with its weight. The organs whose efficiency depends mostly upon the area of their organic surface, like intestine, lungs, and kidneys, have therefore a great advantage. It has been reckoned that the new-born child has two and three fourths times as much external surface for the same amount of mass or weight as the adult. Thus for every 1000 grams of weight the child has at birth 812 square centimeters of surface; at one year, 575; at two years, 533; at seven years, 450; at ten, 412; at fourteen, 354; while the adult at twenty-five has 301.[1]

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[1] Vierordt, *Daten und Tabellen*, p. 152.

[2] *Ibid.* p. 166.

Because of the large amount of radiating surface, the body of the child loses heat far more rapidly than that of the adult. To make up for this loss the child has to produce relatively far more. Thus each kilogram of tissue in a child of five months produces on an average nearly one and one half times as much heat as in the child of eighteen months, 2.2 times as much as in the child of eight years, and 3.3 times as much as in the adult.

Losing so much heat, and having but poorly developed means of regulating, and especially of quickly increasing, the supply, the infant has very little power of resisting cold. Hence the great importance of proper clothing, and the great danger of exposure. The legs and arms of the young child, being very small, expose relatively an especially large amount of surface, and in the ankle and wrist the great blood-vessels lie very near the surface. The trunk of a child may be in a Turkish bath of flannels while its legs and arms freeze. This is a most fruitful source of mischief. The child's tissues are almost embryonic, flabby and watery; hence very poorly suited to rise to any emergency. The adult human body contains 68.0 per cent of water, according to Moleschott; that of the new-born 74.4 per cent. according to Fehling.[2] Certainly the tissues of the child

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[1] Vierordt, *Daten und Tabellen*, p. 36.

[2] *Ibid.* p. 249.

are much richer in water; this diminishes at first very rapidly, later more gradually. The large amount of water favors the diffusion of nutriment to the tissues, and thus rapidity of growth. But it decreases the power of resistance of the organism.

The circulation of the blood is rapid. There is relatively more of it, and a larger part of it is in the capillaries. Each kilogram of tissue contains at birth perhaps twice as much blood as in the adult.

For all these reasons the loss of water is rapid. Hence the importance of frequent baths of such temperature, and so managed, that the child shall not be chilled. Hence also the almost unquenchable thirst of the child, especially during diarrhœa, or whenever the loss of water is in any way abnormally increased. The watery tissues of the child, while less resistant, are more plastic and adaptable; are more easily disturbed, but recover more quickly.

We have already noticed the large size and rapid growth of the infant brain. Starting with a weight of about 380 grams, or more than one fourth of its mature weight, it more than doubles this weight during the first year, and trebles it during the epoch, having at three years of age almost seven ninths of its adult weight.

The nervous system is essential to life, and at the same time very complex. Hence it is started as early as possible in embryonic life, and its growth is forced to the utmost. But however busily and fast Nature may work, — and here she needs no spur, — she can have only a few essential and fundamental portions ready for use at birth. The remaining portions are in a stage of pure growth, and will be gradually matured through childhood and adolescence.

The spinal marrow with its centres for reflex action is capable of performing a certain amount of work. The cerebellum, or small brain, will soon be called upon to coördinate the movements of the muscles of the legs as the child learns to walk. The sensory centres of the cerebrum, or large brain, begin to function very early. The baby sees, hears, tastes, and smells immediately or very soon after birth. The motor centres, controlling the heavier muscles of trunk, shoulder, and thigh, are gradually maturing during this epoch. If all these essential portions can be brought to a fair degree of growth, development, and efficiency, during the brief space of three or even six years, it is all that can be possibly demanded. But these comparatively mature centres form at birth only a small part of the cerebrum. The rest of it is in a very immature, almost embryonic condition.

The chief business of the baby, and of the child as well, is evidently growth. The importance of growth has already been considered. During this and the next epoch all work is of importance mainly as it fosters growth or development. If growth is the chief business, material for growth is the greatest need. A large amount of food must be provided, digested, and assimilated. The alimentary canal of a baby is relatively long and has a large digestive and absorptive surface. According to Uffelmann, a child two years old requires about two fifths as much albumin, three fifths as much fat, and somewhat more than one fifth as much hydrocarbons as the adult.[1] Yet it has attained less than one fifth of the adult weight. To digest and absorb so large an amount of material throws a heavy load upon the immature digestive system. Hence any needless strain should be carefully avoided, and all conditions should be made as favorable as possible. Vierordt calls attention to the fact that the mucous membrane which lines the digestive tract of the infant is richer in blood and incomparably more sensitive, more easily injured, than at a later age. He continues: "The nourishment in infancy differs in essential points from that of later life. It must be very fluid. Thicker, gruel-like foods are at first digested with greater difficulty. It must have a constant temperature corresponding to that of the body. The organism cannot bear great variations in temperature. It must satisfy the great needs of metabolism and growth; and contain suitable amounts of the essential elements, including salts and water. It is of special importance that it should be suited to the digestive powers of the infant. Recipes concerning artificial foods which satisfy the needs of the organism only quantitatively, but have less regard to quality, should be carefully refused as unnatural."

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[1] Uffelmann, *Hygiene*, pp. 703 and 263.

The muscular and nervous systems, which are growing most rapidly, demand large amounts of albuminoids. The various forms of starches and sugars, which the adult craves and needs, are neither needed nor craved in infancy. They merely throw a heavier burden upon a sensitive and already overloaded digestive system. Inorganic salts are needed in large quantities to build up the bones of the skeleton. The best food for the baby wherever possible is its own mother's milk. The mortality of such children is far less than that of those artificially nourished.[1] In Sweden and Norway, where the children are almost all thus nourished, the mortality during the first year was only from 10 to 12 per cent. In Wurtemberg one third of the children are breast-fed. Their mortality was only 13.5. per cent; that of the artificially nourished children was 42 per cent. In Berlin, where a little less than one third of the children are breast-fed, the average mortality for the city was about 30 per cent for the first year. Of course there are many cases where the mother cannot nurse the child. She may have insufficient milk and of poor quality. This is frequently the case where the mother is anæmic or weak or highly nervous.

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[1] Uffelmann, *Hygiene*, p. 54.

When recourse is had to artificial foods we must bear in mind that some of them tend to produce fat rather than solid flesh and bone. The baby appears to be well nourished, his weight increases normally, but he does not really thrive. Here even the scales fail to detect the danger, and only the keen eye of the physician or experienced nurse avails.

Children who have been poorly nourished in infancy may recover and regain their losses later. But frequently this is not the case. Of children born in the famine years in Europe, in 1816 and 1817, an unusually large number proved unfit for military service.

According to Uffelmann, the baby during the first year of life, after the first fortnight, takes about one seventh of its own weight of milk daily.[1] If it is fed cow's milk it takes more, and apparently digests it less completely. Vomiting at this time, unless frequent or continuous, is not alarming. The position of the stomach and the weakness of the muscles closing its upper end make this act far easier and less significant than in the adult.

After the baby is weaned the range of his diet widens very gradually. The food must still be rich in albuminoids and must remain largely fluid. Still the stomach is incapable of thoroughly digesting the thick-walled cells of most vegetable foods. The way for solid foods must be paved gradually. During even the next epoch as well, the child is still solving the problem of digesting and assimilating the largest possible amount of food with a digestive system which is still sensitive and easily disordered.

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[1] Uffelmann, *Hygiene*, p. 686.

But a liberal supply of nourishment is only the first condition of healthy growth. Second is the need of plenty of oxygen, of pure air. The new-born baby breathes about thirty-five times a minute, the adult twelve to sixteen. The figures differ greatly here.[1] There is no doubt that the child uses relatively far more oxygen than the adult, and produces far more carbon dioxide.[2] The child is far more sensitive than the adult to impure or damp air. Probably the excessive dryness of our furnace-heated houses is almost equally deleterious. It is a good deal to expect of a baby that he will thrive in an atmosphere where fairly tough plants die. Hence the value of outdoor life for the child. Dr. Holt tells us that almost the only explanation of the health of many country children who live on unwisely selected and badly prepared food is the abundant fresh air in which they live.

The third need of every growing organism is light and sunshine. Animals produce from a twelfth to one fourth more carbonic acid in light than in darkness.[3] Their temperature is often perceptibly higher. Both these symptoms suggest greater vigor. The effect of a sunshiny exposure on the dampness of the air and on the development of germs is also of great importance. Hence the nursery should always be the best room in the house ; large, sunny, and with large windows. After the baby has outgrown his first shyness of light, the more sunshine in the room the better. The temperature of the room is very important. Every plant has its own special temperature which is necessary for its most rapid growth. This "optimum temperature" differs, of course, in different plants. Wherever man may have first originated, the best temperature and climate for the baby is surely not that of the Desert of Sahara. Dr. Holt again reminds us that the nursery is almost always kept too hot from fear that the baby will "catch cold." Here the thermometer is a much safer guide than the feeling that the temperature of the room, and of the bath also, is "about right."

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[1] Percy, *First Three Years of Childhood*, pp. 346, 353; Vierordt, *Daten und Tabellen*, p. 165.

[2] Vierordt, *Daten*, pp. 176, 24, 352.

[3] Uffelmann, *Hygiene*, p. 21.

Next only to food, air, and light, as stimuli to growth, we must reckon sleep. This is especially necessary during periods of rapid growth, because of the rapid metabolism and the small power of endurance. Even when a year old, a baby sleeps longer than it remains awake. Most authorities tell us that ten or eleven hours' sleep are none too many for a child even six to ten years old.

Thus far we have considered the child almost as a mere vegetable. We have attempted to surround him with suitable conditions, and then to let him grow of himself. But the baby is more than a vegetable, it has a nervous and a muscular system. These also are growing of themselves, almost like vegetables. But they crave and need suitable exercise.

The brain is growing with great rapidity. The whole nervous system is sensitive and irritable. The baby reacts very strongly to slight stimuli. Irritation of the digestive system may produce convulsions. Hence for the growth of this system quiet, rest, and peace are more important than artificial stimuli. Sometimes a tired and irritable baby is rested and put to sleep more quickly by being allowed to lie still than by any churning process, however vigorously applied. The "dendropsychoses" of the child are hardly so fixed and dominant that he can be benefited by being tossed up to the ceiling.

Yet even here we may rush from one extreme to another. It has been found that babies often do not thrive in hospitals which are most carefully and hygienically built and managed. The explanation has been suggested that the baby lay too long, and lacked the massage of the tending of the mother or nurse. The licking, we might almost call it kneading, of the young kitten by the mother, suggests that a certain amount of this massage may be exceedingly beneficial and perhaps essential.

Certain parts of the muscular system begin to crave real exercise earlier than we suspect. Writhing, wriggling, kicking, swinging its arms, reaching, and grasping, are all exercises which the baby keenly enjoys. Soon it begins to creep, and then to walk. All these exercises conduce to health and growth. "A good creeper is a good teether."

Hence from the start the baby should be allowed or encouraged to indulge in such exercise. Its clothing should not hamper movement, much less check respiration or circulation. It should be allowed its time of free movements on a pile of rugs on the floor, if safe from drafts; or on the bed, where it can kick and cavort all it will. The growing muscles are craving exercise, and the exercise stimulates growth not only of the muscles but of the nervous system as well.

We may now consider the mortality of infancy.

Of 1000 children born alive there die during the first year: in Jemtland (Sweden), 90; in Norway, 104; in Scotland, 119; in Belgium, 155; in England, 167; in France, 173; in Italy, 232; in Prussia, 240; in Austria, 251; in Bavaria, 311; in Würtemberg, 360. Uffelmann's book, from which these figures are taken, appeared in 1889. Eross found from a study of statistics of European cities that nearly ten per cent of all children died during the first four weeks after birth; and that of these deaths more than one half were due to congenital debility. Pneumonia was also exceedingly common. The mortality rates of infants decrease steadily with increasing age. The highest death-rate falls in the first week, month, and year.

Greater mortality in cities is universally recognized. Oesterlen states that in seven European cities, of every 100 born there die in the first five years of life 33.6 per cent; in the country, 27.28 per cent. In England, in cities of more than 20,000 inhabitants, 51.39 per cent die during the first ten years; in smaller cities, 46.79 per cent; in the country, 35.4 per cent. In great industrial cities the mortality of children is very excessive. In Manchester, Birmingham, and Liverpool 25 per cent of all children born alive die during the first year. In St. Olaves, 36 per cent; in Chemnitz, 48 per cent. This results from the high birth-rate, allowing

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[1] Uffelmann, *Hygiene*, p. 678.

less care for each child, from poor nourishment, overcrowding, and unsanitary surroundings.

The prosperity of the family is important. Clay reckoned for England that of 100 infants born alive there would survive after the first year: of the highest classes, 90; of tradespeople, 79; of laborers, 68. After the tenth year the figure for the three classes would be 81, 56, and 38 respectively.

The high death-rate in the overcrowded portions of our cities results therefore from a combination of factors besides those already mentioned. Some of these are the weak constitution of the parents, the work of the mother during pregnancy and while caring for the infant, insufficient and unsuitable nourishment, lack of proper medical attendance, prevalence of zymotic diseases.

Zymotic diseases are responsible for nearly 20 per cent of infant mortality. These are rare in infants of the better classes because of the isolation furnished by the home. But in the crowded rooms of the poorer class they are exceedingly dangerous. About 35 per cent of all deaths from zymotic diseases occur under the age of one year, and no fewer than 76 per cent under the age of five years. The older child resists far better than the younger. Of 1000 cases at each age of scarlet fever 392 died in the first year, and only 130 in the fifth.

Whooping-cough is very dangerous during the first year. Croup and diphtheria are often confounded; but croup is more frequent in the second year, and diphtheria during the fourth. True infantile diarrhœa is an exceedingly frequent and dangerous disease among the children of the poorer classes, arising from a variety of causes, but mostly from bad feeding. The great danger of teething is the liability to diarrhœa. The teething in itself seems to be only an irritation weakening the child, and thus rendering him less resistant to digestive disorders likely to attack him at this age.

Uffelmann says: New-born infants suffer largely from general weakness and from digestive disorders. During the remaining eleven months of the first year they are liable especially to digestive disorders, second to respiratory and nervous affections. Infectious diseases are relatively rare. From the second to the sixth years, inclusive, they suffer especially from respiratory affections and from infectious diseases.

We have seen that the constitution of the infant is an hereditary endowment and weak or strong accordingly. The hereditary constitution is usually healthy actually or potentially. The two or three generations immediately preceding us may have some slight tendencies toward disease, but behind them there must have been a long series of sturdy ancestors, or we would not be here. "Madam," said the shrewd country doctor, "don't forget that that baby was made all right. Don't you go and spoil it." Yet this is only one half of the truth, and the other half demands at least equal emphasis. Every one has his weakest spot.

If the children are to be healthy, we must begin with the parents. They should bear in mind that if they are feeble or intemperate, if they have wasted their vital powers in the pursuit of pleasure, wealth or fame, through indulgence, or excess of hard labor, especially of mental and sedentary work, they cannot expect to have entirely sound and healthy children. "Our constitution is an entailed estate which must pass to our heirs with all its worth and incumbrances."

But we are liable to waste a great deal of valuable time in discussing and mourning over bad hereditary tendencies, which can no longer be avoided, when we ought to turn our attention to early environment, which can do more than we yet suspect to eradicate or suppress the worst hereditary tendencies.

One of our worst dangers, one against which every child should be fortified, and against which he can be strengthened almost from the day of his birth, is nervous instability. The child is weak in self-control, lacking in inhibitory power. It is governed or led by, or continually responds to, conditions in its surroundings. It is imitative almost as soon as it can notice. It is remarkably amenable to suggestion, almost as much so as the hypnotized patient. In one word, express it as you will, it is exceedingly impressible. Every impression on the nervous system modifies its growth and influences its mature condition. Hence the surroundings of the infant go far to determine the adult character. A nervous or fidgety nurse or parent, abrupt or too quick in her motions, friends who wish to amuse the baby by abusing him, any or all together can work permanent harm far greater than we suspect. Not only the overt acts but even the mental condition of the attendant are reflected day after day and month after month by the child. Thus his nervous system becomes calm and steady, or weak, unstable, and irritable. And this condition rapidly becomes fixed and permanent.

CHAPTER X

THE KINDERGARTEN PERIOD

We include here the second triennium of life from the fourth to the seventh birthday. The child at three weighs about fourteen kilograms (30 lbs.); at six about twenty kilograms (45 lbs.), or one third of the adult weight. The gain during the whole epoch is about forty-five per cent. It is most rapid during the fourth year, and suffers a marked and often sudden decline in the sixth.

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The height of the boy at three is a little more than ninety centimeters (about 36 in.). At six it is one hundred and ten centimeters (44 in.). The gain in height is about twenty-five per cent, but varies considerably in different individuals and populations. The girl shows a little less height and gain; but the growth of boys and of girls is about the same up to the sixth year. The child has a little less than one pound of weight for each inch of height. The distance from armpit to hip increases over eleven per cent, almost as much as during the next two epochs. The sitting-height is still large in both boys and girls, over fifty per cent of the standing-height. But the portion of the body below the hips gains almost twice as much during this epoch as that above the same point. The trunk is losing. The centre of growth is shifting from the trunk to the legs and arms. The child is stretching. This change in the mode of growth will show its effects more markedly during the next epoch. The shoulders now stand out more sharply from the trunk, mostly because of the growth of the bones of the shoulder girdle.

The percentile increase of the chest-girth is good, almost as great as during the next six years together. The girth is over fifty-six per cent of the standing-height. But this percentage decreases considerably during the epoch. The chest is increasing in breadth far more rapidly than in depth. The upper arm and thigh are gaining more rapidly than the lower arm in the boy. Quetelet's figures for the girl show a quite different result. Here we need better and fuller series of measurements. We should expect rapid growth of the upper arm and leg, for the movements are largely those of the whole limb. The lung capacity of the boy at six is larger both absolutely and relatively than that of the girl. This may possibly be normal, but we should not expect noticeable difference at this age. It is probably the result of improper dress and unwise training. The vast importance of a large vital capacity will become more and more important as we pass to succeeding epochs. At the very beginning of the next epoch we shall find that the girl already shows a tendency to disorders which result from lack of thorough oxygenation of the blood and of outdoor exercise.

If we may rely on Vierordt's somewhat meagre data, intestine, heart, liver, and kidneys are still, relatively to the weight of the body, somewhat or considerably larger than during the next epoch. The preponderance of the vegetative organs, so marked in infancy, still continues, but is gradually passing away. The chief business of the organism is still growth.

The muscles seem to form a larger part of the weight of the body at birth than at any other time during the first three years. Other organs are growing far more rapidly. But about four the muscles of the legs, at least, begin to gain considerably. The muscles of the arms form nearly the same part of the weight of the body as at birth. They are less precocious. The overhang of the shoulders is probably due more to growth of bone than of muscle. The trunk muscles still remain in advance of the others.

We have seen that the brain of the child at three has attained about seven ninths of its adult weight. We may estimate that at six it has attained about nine tenths. The material and energy which were formerly devoted to increase and size are used in some other way. We may be sure that growth or development is still rapid. From this time on a slight increase in weight is accompanied by a steadily increasing gain in efficiency. Of the exact seat of the changes in the nervous system we are still uncertain. The spinal marrow is relatively far advanced toward maturity. The running of the child shows that the cerebellum has already developed much. But this portion has more still to gain than the cerebrum. Probably the motor centres of the cerebrum, controlling the movements of the muscles of trunk, shoulder, and thigh, the less complex fundamental centres, are already well advanced. Even those controlling upper arm and lower leg may very probably be maturing fast. The motor centres of the hand and fingers are still very immature. The finer and more precise movements have been given up in the kindergartens on this account.

But the sensory centres are far in advance of the motor. The eyes are now at their very best, the ears are wide open, everything is still handled with eagerness. Thus this epoch is characterized by great sensory development and efficiency, and by the use of the heavier muscles, especially those of the legs. The child's plays are usually of a quieter sort than during the next epoch.

Atwater says that the child between two and five requires about one third of the amount of food of a man engaged in hard labor ; and somewhat less than one half as much as the man at light work. The amount of food required is evidently large compared with the weight.

The surface of the body is still large relatively to the mass. Hence a relatively large amount of heat must be produced. Metabolism is very rapid. The organism is sparing of energy, and uses all its material for growth. Hence conditions for growth are still of supreme importance. The child who eats well, sleeps well, lives in good air and sunshine, and therefore grows well, has had all his needs supplied, and is doing his whole duty.

The child has " taken his place as a member of the family rather than as an elevated centre around which the whole family revolves." He gradually shares the food of the rest of the family. Still he needs nourishing food which can be easily digested, because of the sensitiveness of the lining of the intestine. If he will take plenty of milk, it may still form one of the best elements of his food. But other things are also needed. The relative proportion of fat required is still large. Hence the desire of the child to have his bread buttered on both sides and on the edges is not without some physiological basis. There is a slowly increasing demand for carbo-hydrates to furnish fuel for the muscles. He learns to like the finer and more easily digestible vegetables. From now on the craving for sugar will increase.

This valuable nutriment will benefit in moderate quantities, and when it will not destroy the appetite for other kinds of food. If given a moderate quantity of sweets each day he will be less likely to overindulge on holidays spent with his grandmother. The craving for ripe and sound fruit is equally natural and healthy. The thirst of the child is still uncontrollable and unabated. The larger amount of water aids the diffusion of nutriment, the removal of waste, and is generally beneficial. The baby was satisfied with one kind and form of food; the child begins to crave variety.

The child needs food at more frequent intervals than the adult. The supply eaten at one meal is soon exhausted if easily digestible as it should be. Naturally the child runs to the pantry in the middle of the morning and again in the afternoon. The slice of bread and butter with a sprinkling of sugar will "stay the empty stomach," and will increase, rather than diminish, the appetite for the next meal. This mid-morning lunch may well be continued through the years of school life. The appetite of the average child is healthy and usually fully as safe a guide as the opinions and prejudices, not to say fads, of his elders. He has his own constitution, organization, and needs, and they are not as ours. At least we might try the experiment of sometimes giving him the benefit of the doubt.

The years from three to six are usually comparatively free from sickness. Still the delicate linings of the digestive and respiratory organs are the most vulnerable points of the body. The young child has successfully passed Nature's first examination and test, and has been found fit to enter upon life. The second great test does not come until a decade later. The young child at home is less likely to contract contagious diseases than during school life. These are also less dangerous than in infancy, for the child has far greater power of resistance.

Not only is sickness becoming rarer, but the death-rate is rapidly decreasing. Thus Hartwell gives for Boston a rate of 37.58 per thousand living in the third year of life. In the fourth year it has fallen to 25.66, a decrease of 33 per cent. In the sixth year it has decreased to 15.65. This is still about four times as great as it will be in the twelfth year, but not much more than one eighth of what it was even in the second year of life. The prospects of the child of three or four are very good.

Still hereditary or congenital weakness may betray itself during these years. Scrofula, rachitis, anæmia, occurring here, to say nothing of chronic delicacy or weakness, are signs that Nature has allowed the child to go on only "conditioned" and on probation, as it were. She will give it a fair trial before condemning it. It is the duty of the parent to see that these conditions and deficiencies are "made up" and removed. This and the following epoch are a golden season for insuring a healthy growth and development. Now is the time for hygiene and preventive medicine. The remedies are mostly few and simple, and the best tonic is plenty of fresh air and sleep.

The kindergarten epoch is predominantly sensory, but even at this age the child enjoys motion. It runs, and will soon begin to climb. It is less restless and more easily interested in quiet games than during the two following epochs. But every desire to run and jump should be encouraged, and the tendency to quiet-ness should not lead us to encourage this as the chief virtue. The clothing, especially of the girl, is often ill-suited to its purpose, which is to insure protection against cold, especially in the legs and arms, and still to allow the greatest freedom of motion.

The kindergarten has proved itself to be an almost ideal school for this epoch. Its success is due very largely to the fact that, in general, it takes children as it finds them, and does not try to force upon them methods of thought and action suited only to the adult. A very careful study of the kindergarten and the child is given by Burk in his "Kindergarten Problem."[1] He finds that the plays of this period can be divided into three classes. The first class includes Plays of Physical Action, — running, kicking, sliding, climbing, throwing, etc. Balls and driving-reins were the most popular toys. "These games give free exercise, but there is a decided lack of games of competition or of force, also of games involving fine accuracy or skill. They involve mainly the fundamental muscles and movements, but afford a great variety of exercise." Burk wisely urges that more of the simplest toys should be introduced to stimulate the play interest and call forth its expression.

Under the second class of Representative Plays occur: being an animal, making things, and representing adult occupations. The child imitates the adult or some animal. Here the sand-pile furnishes endless opportunities. Dolls and housekeeping begin. The weakness of the child's constructive powers is more than compensated by his imagination. "The representative plays of this epoch may be characterized by their fragmentary nature, that is, their selection of a few features; their simplicity as shown in the relation of those playing; and their emphasis of the element of action."

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[1] Burk, *The Study of the Kindergarten Problem.*

The third class, Traditional Plays, like London Bridge, Puss in a corner, tag, etc., were less frequently employed. These seem to demand more coöperation and organization than the child is capable or fond of showing. They become popular at a somewhat later stage. Miniature gardens, where the child can plant, weed, and dig, seem to have been exceedingly successful and popular in some localities.

President Hall's monograph on the "Contents of Children's Minds"[1] opened our eyes to a frequent defect of training during this epoch. Of the children tested in Boston over three fifths had apparently never seen a crow, an ant, a squirrel, or a robin. Over four fifths did not know a pine, an oak, an elm, or a maple. Less than one fourth were ignorant of butterfly, hen, or cow; but one half did not know about frogs or bees. The ignorance of the children of Kansas City was far less pronounced and painful, though bad enough.

The sensory organs are the mouths of the child's mind. Through them the material is taken in which the mind digests and assimilates, and by whose digestion it grows and develops. If the senses are allowed to remain or become dull, the prospect or possibility of the highest and most active intelligence is decreased or destroyed at the very outset. The really efficient man is always a wide, keen, and quick observer. The inventor who has observed the need of the community has already solved one half of the problem of his invention. These powers must be developed now, if at all. Hence their use and exercise should be encouraged in every possible way.

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[1] Hall's "Contents of Children's Minds on Entering School," *Ped. Sem.* vol. i.

The observation of, and interest in, natural objects should become a fixed habit. The child who has never had his eyes thoroughly trained to observe and examine Nature will never love her as he should. All his later life he will wander blind through a world teeming with beauties and miracles. When we fail to encourage sensory development we rob the child of his birthright.

The fibres of the association areas in the brain seem to connect different sensory and motor centres. These connecting fibres are the seat of the highest powers of the mind. At least, this is the most probable theory at the present time. The development of these highest centres proceeds from and depends upon that of the sensory and motor areas which they connect. Here is still another reason for thinking that the intelligence of the individual is best insured and increased by the fullest possible use of the sensory areas now, and of the motor areas when these in their turn begin to crave exercise.

The climate of our Northern States is one of the greatest hindrances to the complete success of the kindergarten. Ideally the child should be trained in the open air and sunshine in free and constant contact with Nature. This is possible in our rigorous climate only during late spring and summer and early fall. Every child ought to have at least one pair of grandparents living on a farm in the hills or by the sea, and should spend the summer, and more if possible, with them. No child should be doomed to life in the city for the whole year. He should have a respite. We must at least see to it that if the child must spend most of its time indoors, the recesses shall be frequent and long, the rooms light, airy, and well ventilated. Most adults have lost the power of recognizing whether the air in a well-warmed room is fit to breathe or not. If the child cannot go to the woods, we must bring the spoils of the woods to him. Yet this is but a poor substitute for the real opportunity.

Finally the teacher of the kindergarten may well be on her guard that mysticism or love of system, the adult æsthetic sense for pleasing games in group or circle, does not rob the child of its inalienable right to individual freedom of action and movement, or destroy its resourcefulness, ingenuity, and power of taking the initiative. The rhythmic waving of tiny hands is very beautiful. But from the hygienic standpoint the use of the heavy fundamental muscles, while apparently somewhat rough, crude, and barbarous, is far more profitable. "This ought ye to do, and not to leave the other undone." The child is not yet saint or sage, gentleman or lady. He had best act and move as a healthy, natural child.

CHAPTER XI

THE CHILD ENTERING SCHOOL

During this third epoch the child is a strange and interesting being, whose organs are at widely different stages of growth or development. At six there is but little difference between the sexes, though the girl already begins to show signs of the precocity which will characterize her future development. The child at six weighs about twenty kilograms (45 lbs.) ; at nine a little less than twenty-seven kilograms (60 lbs.). The girl is a little lighter than the boy. The gain during the epoch is about thirty-one per cent, or two thirds of that during the last epoch. The weight at six is about one third of that of the adult.

The height of the boy at six is one hundred and twelve centimeters (44 in.) ; at nine it is one hundred and twenty-seven centimeters (50 in.). The increase during the epoch is somewhat over thirteen per cent for both boys and girls, a little more than one half of the percentile increase of the preceding triennium.

The ratio of sitting to standing height is diminishing. The increase of sitting-height is about nine per cent. According to Zeising,[1] the distance from hip to armpit increases only about three per cent. Increase of chest-girth is slight, about two thirds as rapid as that of standing-height. The chest-girth at nine is but little more than one half of the standing-height, and the ratio is still falling. The measurements of muscular girths of arm and leg were taken by different observers from different groups of individuals, and are hardly comparable. Hence their increase at this time is still uncertain.

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[1] Vierordt, *Daten und Tabellen*, p. 18.

If all organs were equally developed, each would have attained one third of its adult weight. This is not the case. The digestive system is still in advance of all the other organs. Liver and kidneys are still relatively large, but are fast sinking to their adult proportions. The size of these vegetative organs reminds us that we still have to do with an organism which retains strongly marked infantile conditions and characters, whose chief business is even yet growth fully as much as development. The lungs are small, but the greater ratio of surface to mass, and the more rapid breathing may compensate somewhat for their lack of size.

During this epoch the heart is at a minimum. It has hardly more than one fourth of its adult weight, and has to force the blood over a body which has two thirds of its adult height. This relative decrease in weight and power comes at a time when the muscles are beginning to crave much exercise. This makes far greater demands upon the heart than mere rapid growth could cause. Christopher has already called attention to the fact that other symptoms of heart weakness, such as shortness of breath, are not at all uncommon at this age. Holt accepts this explanation of the child's quick fatigue about the eighth year. Christopher does not hesitate to call it the fatigue year.

It would seem quite possible that the explanation of the crisis, frequently noticed before it was explained, is to be sought in a general condition of the body, which manifests itself in a weakness of several organs. This is the time when the brain has stopped its rapid increase in weight. The permanent teeth appear, symptoms of a preparation for a change in food and in mode of life. Muscular activity is increasing rapidly. The old structure is not fully adapted to the new needs and conditions. It must readapt itself. This period of readaptation, we might almost say of reorganization, is necessarily a period of weakness. If the nervous control of the arteries, the vaso-motor apparatus, is still incomplete, as it may well be, we should expect to find the body ill adapted to meet the new emergencies.

We have seen that about eight in the boy, the strength of the muscles of the forearm is increasing far more rapidly than the cross-section of the muscles warrants. We noticed in Gilbert's investigations that power of rapidity in tapping increases rapidly at the same age. We found that the muscles fatigued easily. These facts would seem to show that the motor centres in the cerebrum which control the movements of forearm and hand are developing very rapidly. The movements of the fingers become stronger and more precise throughout the epoch.

Mortality continues to decrease throughout this and the next epoch. Judged from this standpoint alone, the child is steadily improving in health and vigor. But at eight there is a rapid, often sudden, increase of morbidity. Evidently the crisis or transition is not sufficient to affect life directly. It leaves the child in an unstable, sensitive condition.

Schmid-Monnard has called attention to the fact that about seven, or very soon after that year, the morbidity of the girl begins noticeably to exceed that of the boy, and that the increase is very largely due to poverty of blood and its consequences. We can consider this subject better when we study the next period. It is sufficient to observe here that this points to the great need of exercise and open air during this first crisis. We must not forget that this is the golden time for storing up material and vigor against the pubertal metamorphosis, whose lean years are so soon to follow. Hence the supreme need of the epoch is hygienic surroundings suited to promote general growth and vigor. The child should have plenty of plain food, of air, sunshine, and sleep. Light, air, and suitable desks are an absolute necessity in the school. The lower grades need the newest, most carefully constructed, best warmed and ventilated buildings. They are far more susceptible to bad conditions than the older pupils of the high school.

Curvature of the spine is easily started in this epoch, though more frequent and aggravated in the next. The power of the eye to accommodate itself to different distances is now very great. Dr. Standish has called attention to the danger which springs from this fact. The child feels that he sees an object better when it is held near to his eyes. In reading or study, especially if the words are new or difficult, he holds the book too near or bends over it. He thus forms a habit of near-sightedness which soon becomes fixed as a disease. He needs careful training, and often much reminding, to teach him to keep the book at a proper distance.

We have seen that the craving for exercise of a rapidly growing centre of the brain manifests itself as an interest. Superintendent Taylor[1] has attempted to solve the question as to the interests of this epoch by answers made by children to the question as to what they hoped to do when grown up. He tells us that trades are most popular between seven and nine. An occupation dealing with tools, plants, or animals, appeals most strongly to the younger boys. Many dwell with evident delight on details of farm life. Young carpenters and masons are anxious to make a house, an ice-box, or almost anything useful. More boys between seven and ten wish to be railroad men, firemen, or engineers, or policemen, than between eleven and fourteen. Girls now wish to be dressmakers or teachers. Nearly all children regard handcraft with great favor. Until the age of eleven or twelve they look forward with bright anticipation to the time when they may do manual labor. I have given Superintendent Taylor's words as far as is consistent with condensation.

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[1] "Children's Hopes," *Report of N. Y. State Supt. of Public Instruction*, 1896.

The kindergarten child was quieter, more inclined to use his sensory organs. Almost since babyhood he has been observing and imitating. In imagination he has been and played the part of all sorts and conditions of animals and men. He has played himself into a wider knowledge of the world than we suspect. But his world has enlarged so rapidly that he has not been able to adjust himself to it. Children at this age are predominantly motor and are anxious to know the use of everything. The kindergarten child asks, "What is it?" The child in the primary grades asks, "What is it for?" It is a period of very incomplete development of the highest and finest motor centres, especially of the fingers; and one of quick fatigue. The child is anxious to do and to make. The creating and fashioning instinct is beginning to manifest itself. It is not enough to imitate in imagination and to play that he is doing something. He wishes to realize some of his imaginations.

But imagination no longer covers a multitude of defects, or makes deficiencies good. He feels his lack of success, and is easily discouraged. The kindergarten child draws anything and everything which is proposed to him. Now the child hesitates. Mr. Bailey tells us that if he does not learn to draw before he is nine years old, he will not learn at all in the school. Drawing is only one of many accomplishments where the child now forms habits of hesitation and inertia, habits whose eradication becomes more difficult as years go by. There is a very real danger of his sinking into inactivity or living in an imaginary world, realizing and accomplishing nothing while dreaming of everything.

Triplett finds that the years from seven to nine are characterized by frequency of loss of interest in school work and of failure. It is not impossible that the tendency to drop out of school and go into trade or any kind of work which shows its results several years later may be started now. It is a time of much discouragement for the child, and almost equally so for teacher and superintendent.

Any manual work must be easy and simple, or it will add to his discouragement. He needs much encouragement, and even then accomplishes little. Perseverance and long application to tasks at any one time cannot be expected of him. If the habit could be compelled, it would work more harm than good to his immature nervous system.

His actions are not well coördinated. He is impulsive and restless. Imitation and suggestion play a very large part in his life. We have seen that the higher mental powers do not become evident until the age of eleven or twelve. The child can memorize well and easily, and it is probably a good time for this kind of work. He learns language by imitation, but has no use for rules of grammar. He can acquire arithmetical methods, but finds the explanations offered by book or teacher exceedingly difficult or quite incomprehensible. He sees concrete illustrations of many great laws. He is amassing stores of experience. He thinks much and about many things, but thinks as a child. He is gathering the material out of which he will later frame the ideal, plan, and structure of his life and work. But the material will take form and life after adolescence. Here again, as in his physical life, the caterpillar is storing up material against the time of metamorphosis.

The life of the old New England farm was probably by far the best education for this epoch. "The child grew and waxed strong." He was busied, but not overtaxed. He found plenty of daily tasks suited to his strength and intelligence, which tested his ingenuity, and trained him to take the initiative. He grew up largely out of doors, surrounded by natural objects which continually stirred his curiosity. Even the monotony of life trained him to form habits of patience, industry, care, and of accepting responsibility as he could bear it. No modern system of education can hope or should be expected to accomplish all the good things which under such training seemed to come as a matter of course. We must make good these losses as far as we can, and be grateful for the compensations of modern life.

The child is better off at school than at home. But he needs a peculiar school, course of study, and methods of training and instruction. Let us not forget that in assigning work our question should always be, What and how much will best promote growth? not, How much can he endure? We wish to find the kind and amount of work which will furnish the best and most profitable exercise for those centres in the brain which most crave and need it.

Unfortunately the higher centres of logical thought and inference are not yet mature enough to demand exercise. The lack of mental interests is the great source of difficulty at this period. We often attempt to impose adult or adolescent interests upon the young child. We fail, and his last state is worse than his first. He loses what little interest he ever had, and is fortunate if he does not contract an aversion to the subject and to study in general. The old Greek philosopher said that a child should not learn to read until he is ten years old. Many superintendents say that children in the lower grades mark time, making little real progress. If there are no special interests, teachers and superintendents are not to be blamed if they frankly confess that they cannot find them.

Professor Donaldson says that at this age the course of study should be in the nature of a reconnoissance. Make the exercise general, stimulating all the areas and powers of the brain successively. It would seem to be a time for much variety of work rather than for a close correlation which quickly fatigues. Method seems more important than subject at this age.

But is it not possible that we have been seeking the chief end of education at this epoch in the wrong direction? What the child learns from books by application and mental effort is the smallest part of his acquisitions.

He is now absorbing subconsciously and without much logical thought. He learns through imitation and suggestion without knowing that he has learned. He has learned to talk by imitating his elders. He acquires at the same time their peculiarities, of dialect, idiom, pronunciation, and inflection. These subconscious acquisitions crystallize in habits of speech. In later life he becomes conscious that some of them are bad. He avoids the unfortunate idiom, and is on his guard against it. But in careless moments, when he has relaxed his vigilance, he will surely use it. It has become a part of his real self. The child imitates the gait and manners and almost any striking peculiarity of teacher or parent with like results. Not only habits of speech and action, but preferences and aversions, prejudices and superstitions, æsthetic and moral standards, even religious tendencies, arise, grow, and take form, as the result of surrounding conditions, he knows not how. But these habits of speech, action, and thought soon become fixed and unchangeable, and fashion his whole life. Many or most of the family peculiarities of habit, action, and thought, which we usually regard as inherited, are really the result of the constantly repeated impressions of early environment. These impressions are deep and lasting, and often consciously remembered in old age, when all else has been forgotten.

Our brethren of the Roman Catholic Church can teach us a valuable lesson on this subject. They have clearly recognized the importance of a right atmosphere in education at this epoch. If I am not mistaken, what they value most in the parochial school is not so much the daily lesson or the imparting of information, as the religious atmosphere, the habits of reverence and obedience, the moulding and fashioning of the young life. With a wisdom born of ages of experience, they recognize that the lesson may be misunderstood or forgotten, but that the habit will be permanent.

Many habits which the child does not readily acquire of himself may be developed and fostered by the patience and perseverance of parent and teacher. Habits of neatness and punctuality, of self-control and courtesy, of truthfulness and reverence, and of a host of other virtues, may thus become thoroughly established. They are far more easily acquired now than at any later time. The child expects this sort of training. He lives under an Old Testament dispensation of laws, rites, and ceremonies. He expects that punishment will follow disobedience. When he is held kindly and firmly to a suitable discipline, he is receiving his first and best lessons in habits of morality which are of far greater importance than precepts or explanations. Without this previous training the religious development at adolescence will be feeble, abnormal, and defective. He is gaining at the same time through his affections an education of the heart which is above all price.

We do not sufficiently emphasize the importance of the development of right feelings and emotions. These stand very close to and sway the will. My earnestness and vigor of action depends upon how much I care for certain persons and causes even more than upon how much I know about them. I may know much, and care little, and hence do nothing. "With the heart man believeth unto righteousness," even more than with the intellect; and "out of the heart are the issues of life." Greatheart conquers Giant Despair and kills him, when Swelled Head is utterly defeated. President Hall has well said that the education of the twentieth century will develop the heart as well as the intellect.

The tired teacher in her room in the evening reviews the work of the day. Tommy has been a little more amenable and industrious, and a little less outrageous. And Gladys has been somewhat more attentive and truthful. But language was poor and numbers were bad. If the Commonwealth could speak to that teacher, would it not say: "I care infinitely more for Tommy's habits, and Gladys's thoughts and behavior than I do for all the language and numbers in the world, important as these may be. You are laying the foundations of loyal and law-abiding citizenship."

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The mother, with her monotonous daily round of cares and tasks, wishes that she could give more time to instructing her children. She forgets that her industry, fidelity, cheerfulness, hope, courage, faith, reverence, calmness, kindliness, and courtesy, are all reproducing themselves in the minds of her children. This is education for health, vigor, power, and efficiency, not merely for learning. It builds up instead of puffing up. The child left to nurses acquires the virtues of a faithful servant or the vices of a hireling.

The color-sergeant in Kipling's 'Eathen has the essential characteristics of a great teacher. When his men enter the battle, they do not remember much of all his teachings. But without them they could never have been held in line during the weary hours of waiting and suffering, or lifted through the charge that wins the day. The work of the mother and of the teacher in the lower grades is very similar.

Thus this period of formation of habits, which seems at first uninteresting and unimportant, proves to be the time of widest and grandest opportunity. It would be hard to decide whether the education of the young child or of the adolescent demands the better teacher. The earlier grade probably requires even greater skill and wisdom than the latter. Because the work and personal influence of the primary teacher is less clearly remembered or may be entirely forgotten, we may sometimes be tempted to think that her share in the development of mind, heart, and character is smaller. The pupil forgets who has influenced and moulded him just because the results of her training have become so completely a part of himself that he easily considers them a part of his hereditary endowment. This is the highest possible testimonial to the value and efficiency of her training.

For similar reasons the story has great power and value during this epoch. It is perhaps the best means of leading the child's feelings, hopes, and desires into right channels. Says Miss Bryant in "How to Tell Stories to Children": "A story is a work of art. The story-teller who has given the listening children such pleasure as I mean may or may not have added a fact to the content of their minds; she has inevitably added something to the vital powers of their souls. She has given a wholesome exercise to the emotional muscles of the spirit, has opened up new windows to the imagination, and added some line or color to the ideal of life and art which is always taking form in the heart of a child. She has in short accomplished the one great aim of story-telling — to enlarge and enrich the child's spiritual experience, and stimulate healthy reaction upon it."

During this epoch the end, aim, and method of education is one and the same in the home and in the school. The wisest and most efficient teacher can accomplish little, if not supported by the conversation and atmosphere of the home. If this is materialistic, trivial, or vulgar, all the schools and colleges in the land cannot save the child from philistinism and vulgarity, immorality, or unmorality. If the home atmosphere be one of courtesy and kindliness, justice and honesty, of reverence for God and man, of high thought and feeling and aims, we may look forward to the future with all confidence and hope. Here, at least, parent and teacher may and must find no difficulty in working together. The primary grade should be a sort of home-extension movement.

Evidently during an epoch like this we should lengthen the recesses, multiply pauses between the class exercises, and allow frequent rest and change of position. The great importance of singing has been generally recognized. Marches and simple dances may be very useful. It is an excellent time for observation and nature-study. But after all possible mitigations of confinement, much remains to be done. Schmid-Monnard noticed that German children during the first year of school life lagged in growth or even lost weight. He tells us that children sent too young to school are graduated with little credit or drop out by the way. This is especially noticeable in precocious children with frail bodies or weak nervous endowment. The heavy muscles tingle for exercise, the mental powers are small and very immature. Did Nature ever intend that school-room, desk, and book, should play so large a part in the child's life as they do under our present system? Was it so in old times on the farm? Growth is still the chief business of the child, and development of the sense-organs and of the heavier muscles is almost or quite as important. The mental powers can wait for their exercise, but those of the muscle must be realized and utilized soon, if at all. If there is any truth in our argument that the muscle is the strategic centre of development of all the vital powers and even of the brain itself, muscular and physical training is far more important than mental. We leave the subject here to return to it again in the chapters on physical training, and especially in the discussion of the Value of Play in Education.

We naturally ask: Is there any explanation of the peculiarities of this epoch, its small amount of mental gain, its sudden rise of morbidity in spite of the declining death-rate? President Hall[1] says: "The years from about eight to twelve constitute an unique period of human life. Everything suggests the culmination of one stage of life, as if it thus represented what was once, and for a very protracted and relatively stationary period, the age of maturity in some remote, perhaps pygmoid, stage of human evolution."

The arboreal life of our lemuroid and anthropoid ancestors lasted long. In climbing forms the trunk remains long and the legs short, as in still more primitive quadrupedal ancestors. The arms are long and used for locomotion. When the anthropoid ancestor of man descended from the trees and walked upon the ground, the legs lengthened and strengthened to give a longer and firmer stride. One of the most marked differences between man and all the anthropoid apes is his far greater length of leg and his relatively shorter trunk and arms.

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[1] Hall, *Adolescence*, p. ix.

Ranke tells us that the length of the free leg in the male gorilla measures only sixty-nine per cent of the length of the trunk; in the chimpanzee and orang about seventy-eight per cent; in man 134.6 per cent. In the gorilla the length of the trunk is fifty units, that of the free leg only about thirty-five. In the human being the trunk measures a little over thirty-six units, and the free portion of the legs about forty-nine. By a unit we mean in each case one per cent of the total height. The two portions of the body are about as fifty to thirty-five in length. In the human being the larger portion is in the legs, in the gorilla in the trunk.

A similar, though perhaps somewhat smaller, change in proportions has apparently gradually taken place in the evolution of man. The trunk contains the vital organs which must furnish the income of food, fuel, and oxygen, and remove the waste of the body. The longer and stronger leg requires far more energy to use it properly and effectively. But while the leg lengthens, the trunk shortens; and thus its capacity decreases. This seriously effects the metabolism of the body. Even now the men and women of greatest endurance are those with long trunk and short legs, who have departed slightly less than the majority from the primitive form. Similar slightly more primitive proportions seem to characterize the Asiatic races to-day.

The early development of the child goes on as if to produce just such a body as we find in the anthropoid. The long trunk and short legs are very marked in infancy. During early childhood the development of the legs is rapid, but hardly too rapid to compensate for the arrest of development of the rear portion of the body during prenatal life. Then, probably about the age when our arboreal ancestor was approaching maturity (between seven and nine?), the rapid growth of the legs is at present far from complete. Sexual maturity is deferred until the growth of the legs is nearer completion. But for a time the legs must outgrow the trunk, so to speak. Expenses threaten to exceed income. There must be a readjustment and increase of trunk length to meet the new demands. But this readjustment is not made until the age of fourteen or later, when the trunk begins to increase as fast as the legs. Between eight and thirteen inclusive in the boy, and a little earlier in the girl, there is a time when the growth of the legs has disturbed the economy of the growth of the body. The disturbance is usually not great enough to affect life. The death-rate continues to decline. But it produces temporary weakness, and a tendency to various disorders. Hence morbidity rises until increase of girths and of trunk length, at fourteen and sixteen in the boy, restores the proper balance. The increase in height strains especially the small and weak heart, which, for aught we know, may have been adjusted to a horizontal body. For not a few defective adjustments to the upright position still persist in man. Hence forms of heart-weakness or inefficiency often accompany rapid growth in height. But this is only one of the elements of weakness in the boy between the ages of eight and thirteen, in the girl a year or two earlier.

Every readjustment affecting a large part of the body is expensive, and liable to be exhausting, and to leave little excess of material for growth. The new use of legs, arms, and especially of the hands, required the development of new centres in the brain. Time and place must be found for their development in the life of the individual child. Thus Nature has her hands more than full to meet the emergencies of this epoch. If, as we have reason to believe, the forearm centres in the brain are developing rapidly about eight, those of the fingers probable mature a year or two later. The development of the centres of thought and will must wait for the completion of the lower and essential portions. Hence the development of the highest and peculiarly human mental powers takes place mainly during adolescence. Then Nature, having more nearly regained the normal proportions of the body, and the proper balance of income and expense, has time and material for her crowning work.

Of course any such explanation is largely theoretical or hypothetical, but it seems to accord with and explain most of the facts of anthropoid and human structure and development.

CHAPTER XII

THE GIRL AND THE BOY IN THE GRAMMAR GRADES

OUR study in this chapter includes somewhat more than the fourth triennium. The years which will occupy our attention are those between eleven and fourteen or fifteen in the boy, and between nine and thirteen or fourteen in the girl. The epoch falls a year earlier or later than the average in certain localities and under certain conditions of life. But the girl is at this epoch at least one year more precocious than the boy.

The weight of the boy at twelve is about thirty-five kilos (77 lbs.); at fifteen it is forty-eight kilos (107 lbs.). The gain during the fourth triennium and the first half of the fifth is slow, about thirty per cent, but the marked acceleration in growth in weight during the last half raises the gain to forty per cent for the fifth epoch. At twelve the boy has somewhat more than one half, at fifteen three fourths of the adult weight.

The girl is slightly heavier than the boy both at twelve and fifteen, for her acceleration in growth in weight comes a year or more earlier. Her gain for the fourth and fifth triennia is a little more than thirty-five per cent. She has at twelve two thirds, and at fifteen nine tenths, of her adult weight at twenty.

The height of the boy at twelve is 140.7 centimeters (55 in.); at fifteen it is 159.8 centimeters (63 in.). The gain during the fourth triennium is about eleven per cent, during the fifth about fourteen per cent. He has at twelve four fifths, and at fifteen nine tenths of the adult height. The girl at twelve is about two centimeters or nearly an inch taller than the boy; at fifteen she is about three centimeters or a little more than an inch shorter. Her gain during the fourth epoch is about thirteen per cent, during the fifth a little less than ten per cent. She has attained at twelve almost nine tenths of her adult height, and at fifteen is practically full grown. Here, however, there is much individual and family variation. The boy at twelve has about twenty-five, and at fifteen a little over thirty, kilos weight for each meter height. Or at twelve he has 1.4 pounds weight per inch of height; at fifteen 1.7; at nineteen about two. The relative weight is slightly greater in the girl.

The strength of squeeze in the boy is at twelve about forty per cent of that at twenty, and at fifteen about sixty per cent. The ratios in the girl are much higher on account of her precocity and because of her much smaller adult strength. The growth of the internal organs is generally slow between nine and twelve, but quickens during the next epoch. The rate of metabolism is sinking toward the adult condition. During the fourth epoch the heart is still small and light, the arteries are large, and the blood-pressure is low. Heart, lungs, and muscular girths are increasing slowly. Their period of accelerated growth will begin about the fourteenth year in the boy and somewhat earlier in the girl. The death-rate is very low, but morbidity is rising to its first maximum about thirteen. At nine or ten there may be a slight improvement in morbidity.

The tenth year in the girl and the eleventh in the boy are years of very slow growth in both weight and height. This retardation of growth may be hastened or postponed a year in different localities. The girl is a full year more precocious than the boy, and her year of minimum growth may fall at nine. The slackening of growth is usually less marked in her case. Her development is more crowded and hurried. Series of changes, which go on more nearly successively in the boy, are often telescoped, as it were, in her case.

Nature economizes her material, husbands her resources, and, as Quetelet says, rallies her forces against the critical pubertal period which is close at hand. The period of rest and economy is followed by a period of very rapid increase in height, lasting three or four years in the girl, and a year or two longer in the boy. The term of rapid increase in weight and girth begins a year or more later than that of increase in height. The result is that for two or three years the child is lean and lank, and looks as if it had been violently stretched. It seems to be all legs and arms.

All growth is expensive. Except during early infancy much material is consumed to add very little, and each additional pound costs more. But additions to the length of the limbs are especially expensive. The growth starts in the bones. These lengthen, and muscles, nerves, and arteries, must all be stretched and readjusted to the new conditions. The longer leg is a longer lever, fitted to give a longer stride and greater speed. As it lengthens, it requires more force to move and control it. But the addition to the length of the muscles has not increased their strength. For a time the new material may be a source of weakness, and sometimes of pain. The needed increase in girth follows later. The brain also must become accustomed to the new conditions. The cerebellum, owing to the changes in the length of the legs, and in the proportions of their parts, must change its habits and rhythms in discharging its impulses. Walking must be learned almost anew. This is no easy matter. The boy stumbles over his feet, and the girl is ungraceful. They are conscious of the fact, but cannot understand it. Neither of them knows what to do with hands and arms. It is a trying time.

With all possible economy the expenses of the body are increasing in several ways. Growth is in itself an expensive process, and demands the combustion of a large amount of material.[1] The baby uses two or three times as much food and oxygen for each pound of weight, and produces as much more heat and waste, as the man engaged in moderate labor. Much of the food is consumed, and only a small part added to the weight. And the gain of each additional pound each successive month and year demands an increased amount of waste. The baby during the last half of the first month requires, according to Camerer, about twenty grams of milk for each gram's gain in weight. During the fourth and fifth months, it requires at least twice as much for the same gain. Between the middle and end of the first year the ratio doubles once more, and the baby is very economical.

The body is increasing in three dimensions, but the strength of the muscles is proportional to the area of the cross-section, which increases in only two, and slowly at that. The weight to be carried is outgrowing the strength. This demands effort, and increase of expense out of proportion to the result. The surfaces of the internal organs of the body can hardly be keeping pace in their growth with the mass of the body, though of this we are not quite certain. Hence, relatively less food and oxygen are absorbed, and the waste is less rapidly and thoroughly removed. Finally the process of readjustment is always very expensive of material and of nervous energy. All these causes of increase of expense and of relative decrease of income would be true and effective, if the internal organs were gaining in size and weight as rapidly as the mass of the rest of the body. But this is not the case.

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[1] See Vierordt, *Daten und Tabellen*, p. 284.

The food and oxygen must be furnished, and the waste removed, by the organs in the trunk. The increase in the size of the trunk must be proportional to their growth. But we have seen that the chest-girth was fifty-four per cent of the standing-height at six, and now is hardly fifty per cent. Between six and twelve the distance between hip and armpit is increasing only one half as fast as between three and six, or as during the latter half of the next epoch. The ratio of sitting- to standing-height is lower than during any other epoch, except for a time at the beginning of the next. If both girth and length of trunk are relatively low, the capacity of the trunk must be small, and the efficiency of the internal organs more or less diminished. These ratios will improve at fourteen, and again at sixteen, in the boy, and a year or more earlier in the girl. But during this closing period of accelerated growth in legs and arms, the ratio of income to expenses, the relation between production and removal of waste, has been badly disturbed.

Similar ratios in the adult would be symptoms of weakness, if not of disease. Great stature is usually due to great length of legs. Tall people usually have relatively short trunks. Dr. Baxter found the smallest percentage of men unfit for military service among those one or more inches below the average height. The percentage was largest in the case of the tallest. We have seen that small men with long bodies and relatively short legs are usually considered to have the greatest endurance. A chest-girth less than one half of the standing-height is a discouraging sign. Small weight relative to stature is always unfavorable. Yet all these unfavorable signs characterize this period. They must characterize it, for the growth in the length of leg and arm has lasted long, and must now be hastened to give place to other processes.

Increase in height and greater length of leg generally characterizes the more favored classes. This may be due to better food and surroundings. In so far it is probably a sign of better health. It may be one of the weaknesses which come with higher civilization. Dr. Baxter's observations favor the second explanation. But this question remains open. The fact of their greater height remains, whatever be its cause. The greater growth of the legs enhances for them the difficulties and disadvantages of this epoch. Hence we should not be surprised to find that this epoch was more likely to be one of weakness among the children of professional and business classes than among those of the laborers.

We should not confuse an apparently normal, though marked, increase in height with those cases where, through disease or other causes, the increase of the length of the bones becomes pathological, as is sometimes the case with poorly nourished individuals of weak inheritance. Here it is possible that another explanation may come nearer to the truth. In castrated individuals, whether men or animals, the legs are usually longer than in the normal. It has been inferred that the maturing of the reproductive system puts an end to their growth. If through weakness, or any cause of such sterility, the reproductive system fails fully to mature, the increase in length of the bones may continue abnormally. There may well be a series of intermediate stages between such evidently pathological cases and those where luxury, idleness, weakness of constitution, or poverty and want among the poor, have hampered or prevented the full development of the reproductive organs. We are here brought face to face with a series of important and exceedingly difficult problems.

A year of slow growth and the beginning of the acceleration of growth in height usher in the critical period of puberty. Now comes a metamorphosis almost as marked as the change of the caterpillar into the butterfly. Every organ in the body is more or less modified. The changes in the girl are probably more profound than in the boy. They occur earlier, before we expect them. They are accomplished in a briefer time, and hence are more hurried. Her pubertal period is more likely to be stormy, and her rate of morbidity is higher.

Her future health and happiness, if not her life, depend upon the successful accomplishment of this metamorphosis during the trying period of rapid increase in height. Slight injuries or defects, now easily remedied, may result in temporary or permanent weakness or invalidism, if neglected.

We must not forget that she is now making her final preparations for Nature's second and most searching physical examination. Almost anything else except readiness for this test can be postponed or even neglected without irremediable loss. But failure to meet Nature's requirements means ruin, and a low mark means lifelong disabilities, if not weariness and pain. The test will soon be applied once for all, and must be final. There is no appeal from the verdict, and no forgiveness for those who even ignorantly have sinned against Nature's laws.

We have compared the changes at puberty to the metamorphosis of the butterfly. This is far more than a mere analogy. The changes are comparable, but in the butterfly they are written large. We can learn some valuable lessons from a caterpillar. During its larval stage its whole business is to store up material for its metamorphosis. If it fails in this, it dies; or a sadly weak and defective butterfly emerges from the cocoon. Similarly in the child the years before ten furnish the golden opportunity to store up material and vitality against the lean years of puberty. If this opportunity be neglected or only half-used, it never returns. We should utilize it to the utmost.

But much remains to be done after ten. The rapid growth, the readjustments, and the profound changes in all the organs involve much destruction of material and waste of tissue. If this waste is not removed, it poisons the blood, hampers all the functions, depresses the nervous system, and produces disinclination to exercise or effort. Headache, loss of appetite, pallor, nervousness, and general weakness follow. In Sweden from the twelfth year the rate of morbidity did not fall below sixty per cent until the nineteenth in girls. In Denmark it was forty per cent or more. For the boy it was between thirty and forty per cent in both countries. Schmid-Monnard has called attention to the fact that the greater amount of morbidity among girls at this epoch is due almost entirely to poverty of blood and to disorders which result directly from this. He tells us farther that this difference between the sexes is first noticeable at seven or eight. The deterioration begins much earlier than we suspect. The condition of the blood must be due to one or both of two causes, accumulation of waste material, or deterioration through loss of appetite or decrease of digestive and assimilative powers. The second condition is almost a necessary result of the first.

It would be very strange if such a condition of the blood and whole organism should not be attended by decreased power of resistance to fatal diseases. These diseases may not culminate in death until years later. But it seems not at all improbable that this is the time when they gain entrance into and foothold in the system. When we read the last chapter of Havelock Ellis's "Man and Woman," we learn that the woman is really tougher and has more vitality than the man. We begin to wonder whether the same should not be true of the girl compared with the boy.

Burgerstein[1] tells us that in Sweden and Finland between 1755 and 1805 the mortality of males was greater than that of females, at all ages. Between 1816 and 1855 exceptions to this rule begin to appear. Between 1856 and 1870 mortality of females was greater in most of the pubertal years. Between 1871 and 1880 the mortality of females was greater at all ages between twelve and sixteen. In Boston, according to Dr. Hartwell, between 1875 and 1890 the death-rate of girls was higher than that of boys at all ages from thirteen to eighteen inclusive, except in the seventeenth year. In Berlin the death-rate varies, being sometimes higher among the girls, sometimes among the boys.

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[1] Burgerstein and Netolitzky, *Handbuch der Schulhygiene*, p. 506.

Consumption is a disease which gains a foothold when the body is weakened, and which is repulsed or driven out by open-air life, abundance of exercise, of nourishing food and of sleep. We have already quoted Sir Crichton Brown concerning the prevalence of consumption among the more cultivated and highly educated young women of England. He tells us that after the age of thirty-five more men than women die of this disease. Between twenty and thirty-five the numbers are almost equal. Between five and twenty far more girls than boys die from this cause, and that their death-rate between fifteen and twenty is three times as great as that of boys. What few figures I have been able to find are not really comparable to those of the English physician. They lead me to hope that the ratio in America is slightly more favorable. We can only hope that some of our physicians will furnish us an answer to these and other vital questions of preventive medicine.

Miss Foster, in her summary of the results of a study of the physique of college women, says: "All the measures which are determined in early life are good — the college girl had the favorable conditions of the 'leisure' class. The legs, which get a certain amount of exercise inevitably, are good in bone-measure, but muscularly a little below par. The upper limb has been delayed in growth, and girth-measures of bone and muscle *both* are deficient. Why? I think it is fair to say, because

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[1] Hertel, *Overpressure*, Introduction. See p. xxx.

the brain has been developed at the expense of the body during the last years of school life."

Our facts and figures are, perhaps, too few to demonstrate anything. But they furnish food for thought, and certainly lead to the suspicion, at least, that our modern civilization and education are bearing harder upon the girl than upon the boy. Even if the increase of disease and the higher death-rate is not due to conditions but to the constitution of the girl during this epoch, it is clear that every precaution should be taken to avoid crowding and harassing during this time of weakness.

Let us return to undeniable facts. The great changes in the body have increased the amount of waste in the blood, and this waste must be rapidly and steadily removed by organs in an undersized trunk. It is a second fact that the waste will not be removed until it has been thoroughly oxidized by an abundant supply of air absorbed by the blood at the lungs. Hence the great importance of a large lung capacity. Whether the average for the boy is as large as it should be and might be is very doubtful. It is certainly not excessive.

The girl throughout this epoch is somewhat taller and heavier than the boy of the same age. She needs as much oxygen as he, or even more. The average girl at this period has for each pound of weight hardly more than three fourths of the vital capacity of the boy of the same age. But the woman between twenty and thirty has also about the same ratio. This in the case of the latter is due to her smaller waste and great economy of material. We do not yet know whether her small adult vital capacity is a natural characteristic, or in part, at least, a result of wrong conditions and habits of life. Most adult women lead a sedentary life.

and take far less muscular exercise than is for their good. Their health "flies out through the nerves" faster than it can "come in through the muscles."

The best way to solve the question whether the girl during this period needs a larger vital capacity is to notice the result of moderate exercise at each age. As long as she responds promptly and markedly to simple exercises, we may be sure that it is needed and that the increase is entirely normal, natural, and beneficent.

Dr. Anderson's measurements of vital capacity were taken from girls in a school in the city of New York where gymnastics formed a part of the daily course of work. We may well compare them with Hastings's figures for Nebraska school-girls. The New York girl at six had very small lungs, only four fifths as large as those of the Western girl of the same age. At seven and eight she hardly keeps pace with her Western sister. Play and life in the open air of the country can furnish adequate and suitable exercise during these years. But at nine and ten her percentile increase is more than twice as great. There is an acceleration at eleven instead of a retardation, as in Nebraska. At twelve and fourteen she has one third more lung capacity. Dr. Anderson's measurements stop at fifteen. We do not know whether the superiority was fully maintained in later years. But the girl responded to exercise promptly and most efficiently, and had the increased capacity during her years of greatest need. This one experiment has almost the value of a mathematical demonstration of the girl's needs and possibilities.

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There is a noticeable difference between the tables of lung capacity for boys and girls. In the boy we are very rarely disappointed in an accelerated increase at fourteen, then a year of comparative rest followed by a still more marked increase at sixteen. The accelerations may, of course, come a year earlier or later. But in the case of girls the figures are very irregular. We can find no special periods of acceleration and retardation which remain constant in different localities. This in itself arouses the suspicion that bad conditions are hampering her development far more than that of the boy. We may judge from Anderson's figures that her period of acceleration would probably come early, perhaps even at nine and eleven. But we must bear in mind the precocity of the city girl, especially in the higher classes. Very possibly the acceleration would come a year or two later in the country population.

Evidently the girl sadly needs the larger vital capacity, and gains it when she has the opportunity for suitable exercise. Gilbert[1] observed that dull pupils have a smaller lung capacity than bright ones at all ages during the pubertal period. He thinks that his measurements for other ages give only negative results. But when we notice the irregularities due to the small number of observations and make allowances for these, it would seem to be probably true of all ages. Increased vital capacity might prove beneficial to the mental as well as to the physical well-being of many weak and backward boys and girls at this time.

The oxidization and removal of waste, as well as the increased vital capacity, is best attained by abundant and free open-air play, though where this is impossible, the gymnasium must make good the lack. Such exercise is essential to stimulate the healthy growth and action of the heart and all the vital organs, and to maintain the appetite and assimilative powers.

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[1] *Researches on Mental and Physical Development of School Children.*

About this time the girl's brother joins a baseball nine, and she frequently ceases her outdoor games altogether. Sometimes she still plays a game of tag or some other running game, but is usually ashamed of these relics of childhood. She is very fortunate if she is not continually reminded by mother, teacher, or friend that running, jumping, and romping are more befitting to a tom-boy than to a young lady. A word to the inexperienced as well as to the wise is often sufficient. She gives up the play habit, and forgets the art, just when she needs them most.

Miss Hill, of the Department of Physical Training at Wellesley College, once said: "The most helpless people I have ever seen have been college girls when I have first taken them into the gymnasium and told them to play. They seemed to have forgotten, or never to have truly learned." We hope that the college woman of to-day has improved in this respect, but there is every reason to fear that the girls in our grammar and high schools have not. The man or woman who would discover or invent an attractive game furnishing suitable and convenient exercise to girls of these grades would be one of the greatest public benefactors.

Lack of oxygen and deterioration of the blood often disinclines the girl to the open air and exercise which she most needs. In many families her services out of school hours are needed to relieve the already overburdened mother. Yet in these same families the boy is often excused from all care of his own room and is allowed to leave it in chaos for his sister to "put to rights" for him. This is a decidedly unfair division of labor. It is the lightest work which she can do listlessly, and over which she can consume a large amount of time with little or no muscular effort, which does her the most harm. Of such work the boy should and could do his share.

Life is dull and she craves diversion and amusement. The temptation is great still farther to exhaust eyes and brain by lolling on the sofa or over the furnace register and reading trashy novels. In the worst cases the disorders become so deeply rooted that it is almost or quite impossible to eradicate them. A longer or shorter period of invalidism, perhaps permanent weakness or death, at nineteen or twenty, is the natural result.

The critical period in the girl's life is evidently between ten and fifteen, earlier than most of us think. The time to begin to take precautions is several years earlier, at seven or eight. Most of our care and thought goes to "locking the stable door after the horse has been stolen." Everybody is intensely interested in the health of the young college woman. This is as it should be. Few seem to think that the health of the girl in the grammar grades demands any care or attention. There could hardly be a worse or more dangerous mistake.

It is not a period of immediate danger nor one of great essential and unavoidable weakness; although it is one of diminished vigor, and requiring care, attention, and hygienic conditions. Open air, sunshine, good food and cheer, and abundant sleep are the best tonics. Suitable gymnastics are very useful or positively necessary. But, to be effective, they should occur more frequently than two half-hours each week. This is about as useful as to prescribe two fair meals a week as a cure for leanness. Idleness is neither necessary nor beneficial. The higher mental powers are developing and craving exercise. The boy and girl are drawing inferences and making distinctions. A reasonable amount of school work will promote both mental and physical health and growth. But overpressure, confinement in hot, ill-ventilated rooms, long sitting without change of posture, needless fret and worry should be most carefully avoided.

The girl is in the last years of the grammar school or in the first year of the high school. She is interested in her work and ambitious. She may have inherited from her mother an old-fashioned New England conscience. She does not intend to be left behind in any social, literary, or other competition, into which she has entered spontaneously or otherwise. Very possibly she is looking forward to that relic of barbarism, the examination for entrance to the high school.

She may be preparing for college. The school has a reputation to sustain, and the public demands that it satisfy the requirements of the college for admission. Whether these requirements are reasonable or not, the docile public does not ask. Perhaps, like Gallio, it "cares for none of these things." The success of most of our high-school teachers is estimated and graded according to the entrance mark or the standing of the girl in her college studies. Some of them, both male and female, are exquisite products of the culture of our higher centres of learning. They revel in Latin prosody, or in higher mathematics. They can tithe the intellectual mint, anise, and cummin, with balances so fine that they turn under the shadow of a hair from the beard of the prophet or critic. They never studied physiology or hygiene, and consider such subjects as unworthy of their attention. Red blood is at a discount in their valuation. The care of the girl's health is not their business.

But an overwhelming majority of our teachers appreciate the value of health and the need of mercy, and would gladly give the girl a chance, if the public would only allow them to do so. They are all well aware of one fact: that the parents who have criticised them most severely for crowding the girl will be the first to demand their discharge if she fails to pass her examinations for entrance to college. They are quite right in this thought. They all wish her to carry off honors in their own special departments. Every one demands all the time and effort she can secure. If the pupil is exceptionally bright and vigorous, she will endure the strain without evident injury. Whether it is too great for good and profit is quite another question. If she happens to have a year or two at this time when for lack of oxygen or for some other reason her brain refuses to do its utmost, she is conditioned in some study. The school rightly and mercifully refuses to allow her to carry an extra study the next year and thus to make it up. But the father and mother besiege the superintendent, and the girl is finally allowed to add it to the burden under which she is already struggling.

The teachers in our women's colleges are learned, intelligent, very highly cultured, and ambitious. They have been eager to prove that the average woman has more intellectual ability than any man. This question any man of any experience will unhesitatingly and emphatically answer in the affirmative without the evidence of a college diploma or degree of Ph.D. Every alumna is quick and proud to claim that her institution has a far higher standard of scholarship than any other. Easy admission in any study would be a disgrace. The colleges are crowded, and teachers and alumnae fear that a slightly lower standard will attract to them the ill-prepared, inefficient, or incapable. News goes abroad that some college has raised the standard of admission in some subject; every other college accepts the rumor, and follows the example. It is claimed that the requirements of our best women's colleges are fully equal to, or higher than, those of Harvard. Still they rise. How high will they be ten years hence? The college has no means of knowing how many fall by the way. These in no way affect it. The standard is maintained, and that is the great desideratum.

The pressure extends farther back in the course than some of us have suspected. Latin is usually begun in the first year of the high school, or sometimes in the grammar grade. Physical training can wait; but Latin must be begun early, and the foundations must be deeply and thoroughly laid. The high-school years are already full to overflowing. There is a widespread opinion that the first year in the high school is the hardest in the whole course. It certainly is anything but easy. Furthermore, work which was formerly done in the high school must now be done earlier, and the steadily increasing pressure crowds farther and farther back into the lower grades. The study must be pursued, not when it is most profitable, but as early as possible in order that its completion may make room for something else. The pressure affects not only the girl who is fitting for college, but all her associates. In our smaller schools separate courses and classes cannot be provided for those going to college. All must move on together in lock-step.

About this time the parents usually awaken to the fact or hypothesis that the girl has great talents for music, drawing, or painting. They add a few or a good many hours to the week's work. There is little or no time left for outdoor exercise or play. The girl begins to look pale and tired. She evidently needs rest and recreation. Therefore she is allowed or encouraged to go to parties or dances lasting into the wee small hours. It is an excellent method of girl homicide, not always as painless in the end as it looks.

The average American woman ought to be unusually healthy. The toughest, sturdiest, and strongest of the European populations were sifted out to plant America. We can live for some generations on the store of vitality bequeathed by our ancestors. We are certainly drawing very freely on our heritage, if we are not actually squandering it. We can exhaust it. Says Dr. Engelmann in a most careful and painstaking discussion of this subject: "We must admit that the condition of the American girl is not what it should be under the unusually favorable conditions of her life, or which is justly hers by the splendid heritage of health to which she is entitled. The younger the girl, the nearer the period of puberty, the more impressionable the system, the more susceptible to influences for good or evil; and most harm is wrought in the first year of functional life. The majority of those who, after the high-school period, enter upon physical work, date their suffering to the fourteenth year, that is, during school life." [1]

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[1] "The American Girl of To-day," *Am. Phys. Ed. Rev.* 1901.

It is important that the pubertal metamorphosis should be postponed as long as possible. The development of the girl is too crowded. Anything which hastens its coming should be carefully avoided. It comes earlier in the city than in the country, about a year earlier in girls of high schools, normal schools, and those fitting for college, than in the laboring classes. Hence all that tends to nervous strain or excitement should be as far as possible avoided or mitigated before as well as during this epoch.

Our system of education has been framed by adults for adults. Our school boards have mostly forgotten, if they ever knew, that puberty is a period requiring care, attention, and some mercy. The influence of the entrance requirements for college has been often unfortunate in the case of both boys and girls. The teacher is frequently prevented from showing the leniency which she would gladly exercise. She is frequently crowded by a public proud of the defects of its school system, to say nothing of boards of examination and of certificates, etc., etc.

We need teachers with clear and watchful eyes, who can lighten worry, fret, and weariness; and can see when leniency is needed and when firmness is kindness; who know when not to notice a bad error or recitation, or even day's work; who can pass over or advise a day's absence from school now and then. Enough knowledge of physiology to enable her to persuade the girl that wet feet or damp skirts are very dangerous at this period, will certainly do her no harm. We need wise and sympathetic teachers; but we need equally or more a public sufficiently educated to appreciate and support them in their efforts. At present we are more likely to blame them for that which they cannot and we will not change.

At all cost the school should provide for play, exercise, and recreation. The single session lasting continuously too many hours and postponing, if not destroying, the midday meal, is anything but hygienic. The recesses should be lengthened, and pauses for rest and change of position should be allowed between class exercises. More place must be found for all forms of physical training. In some way the blood must be drawn from the brain to the muscles, the life-savers and accumulators of health and strength for the body.

But puberty demands care and hygienic treatment in the home even more, if possible, than in the school. Here the responsibility rests mainly upon the mother, though the father might well spare a moment or two from the more important pursuit of wealth and reputation to give a thought to the health of his children.

Until the menses are thoroughly established, and occur with regularity, the girl should have almost complete rest whenever they occur. Possibilities of chill through damp feet or skirts, or exposure to cold, should be carefully avoided. The girl should be kept cheerful, and all fear of or shame at this natural process should be removed. This is a time when the "ounce of prevention is worth more than a pound of cure." Here, too, especially the wise mother will seek the advice of the experienced physician before it is necessary rather than afterward.

Throughout puberty mental hygiene is as important as physical. The nervous system shares the weakened condition of the whole body. It is liable to be disturbed by any disorder of function. The strain of accommodation to new conditions, of arranging a new distribution of nutriment in the body, of receiving and controlling a host of new impulses from within and from without, falls heavily upon it. Every period of transition is one of greater or less nervous instability. This nervous instability, amounting often to irritability, frequently manifesting itself in stuttering, sometimes in hysteria, is very evident at this great transition. "Sweet reasonableness" cannot always be expected.

Hence cheerful surroundings at home and abroad are of the greatest possible benefit. A bright young girl once said: "I am well enough, if people do not ask me about it." The attention should be kept on bright subjects of thought, not on symptoms of weakness. It is not the best time for self-examination or for cultivation of the conscience. A nervous, nagging mother and an irritable father, precisely those whose children are most likely to show signs of nervous weakness at this period, can work great and irremediable mischief. They would best send the girl to a calm, cheery grandmother or to the right school.

Cheerful parents and friends who know the beauty of God and His world, who see and dwell in the bright side of life, who are watchful without showing it, and hopeful at all times, are the best possible tonics for the nervous system and the whole body, as well as soul.

What has been said of the girl applies to the boy to a somewhat less extent. Puberty begins a year later with him. The year of retardation usually falls at eleven. The period lasts two years longer. It is thus less crowded and hurried. The changes are slower and more gradual, and hence there is less morbidity. He is usually blessed with more obtuse nerves, and great perseverance in the avoidance of overwork. He will generally manage to have his outdoor sports, whatever happens. Hence he maintains a larger lung capacity, and suffers far less from anæmia and its consequences. But there are far too many exceptions to this rule. There are the shy, the sedentary, the studious, boys. There are boys of delicate constitution and of hereditary weakness. There are many boys who are more or less weak nervously, especially during this period. All these need care and attention. In all cases it is the critical period of least vigor. Let us not grudge even the strongest their freedom and sports. Let us not neglect their physical training. There is no danger that they will amass more health and vigor than they will need in adult life. The boy has his tests and ordeals to face. His death-rate at nineteen and twenty is higher than that of the girl. Watchfulness, care, and a grain of mercy will help him as really as the girl. Both need help and sympathy.

CHAPTER XIII

THE BOY AND THE GIRL IN THE HIGH SCHOOL

During the last years of the high-school course we are dealing with adolescents. The characteristics of this period appear more clearly when the youth is sent away from home to enjoy the greater freedom of the academy, or at a slightly later age in early college life. But signs of their coming are already plain, and we may well consider the years for which the high-school course is preparing, and to which it furnishes the transition. In this chapter we shall consider the boy especially. But most of what is true of him will probably apply fairly well to the girl also.

The girl at sixteen has usually attained her full height, and practically her adult weight; although weight in both sexes should increase slowly until into adult life. The boy has somewhat still to gain in both respects. The lungs of the boy have increased in capacity very markedly at fourteen and sixteen. In the girl the increase is less marked and regular. In both sexes the heart, which was small before and during early puberty, has gained greatly in capacity. Its increase during these years may amount to one hundred cubic centimeters, or even more, a gain of sixty per cent. In the boy the increase is usually somewhat slow and gradual, in the girl it occupies a shorter period, sometimes only two or three years. But sometimes the increase is delayed for one or more years. In this increase much new material is necessarily added to the walls of the heart, which require a considerably longer time to attain the strength and endurance of full maturity. The arteries have expanded less than the heart, hence the blood-pressure has risen. The higher pressure and better oxidization of the blood lead to a rapid combustion in the muscles, and especially in the brain; all the more as the waste products of growth and readjustment are not poured into the blood in nearly as large quantities as during puberty. The machine should now be in "smooth working order."

The brain has attained practically its full size and weight. The later additions are mainly in the association areas, where a few more grams of substance, developed just where it is most efficient, may add vastly to the mental power. The sensory and motor areas are fully matured. Improvement is now to be expected mainly in quickness and precision of movement, and in complexity of action of the finer muscles of wrist, hand, and fingers.

The higher mental areas are in a stage when a goodly amount of exercise will do them no harm. The logical powers are increasing fast. They crave exercise, and the boy often argues quite as much from the love of debate as from the desire to attain truth. It is doubtful whether the memory is either as quick or retentive as during earlier years. Mortality is still low, but is gradually rising. Morbidity should decrease, and usually does so in the boy for a year or two. In the girl it frequently remains high continually until after cessation of growth, when it reaches its second maximum in both sexes.

It is difficult to decide just how much of the disorder at this second maximum is avoidable. Growth after fourteen or fifteen in the boy, and from an earlier age in the girl, tends more and more to increase of girth. It is more in the trunk, and less and less in the length of legs and arms. It is less disturbing, and adds more to the size of the vital organs. The body is returning toward the healthy proportions of childhood. It certainly seems as if the high rates of morbidity at seventeen or later in the statistics of the schools of Sweden and Denmark should be lowered. But at best the last years of academy and high school and the first year of college life are likely to be years of much morbidity. The health of pupils during these years will always require attention. After this time morbidity ought to show a rapid decline. We may feel sure also that proper care and exercise during the early years of the high-school course would delay and mitigate its rise and hasten its fall.

Vigorous physical exercise is still needed, and can do only good. The muscles are ready for their final training. Play is not enough. Gymnastics are needed for the development of the finer muscles and the higher motor centres, and for the correction of faults and defects which have outlasted or come with puberty. Their hygienic value also ought not to be underestimated. Still we must fortify and strengthen the youth against the diseases which cause the rise of death-rate at nineteen and later. Nature's second examination has not yet been passed.

Athletics are exceedingly useful. The boy should be allowed and encouraged to test his strength against that of his fellows. They should be arranged and controlled so as to engage those who most need them as well as the few strongest who need them least. We must remember also that the heart is still weak and easily strained. Century runs with the bicycle and long halves at football should be carefully avoided. Precocity of prowess or distinction in athletics is likely to result in staleness or weakness in later life. We should not forget this fact which was discovered and mentioned by Aristotle of the contestants in the Greek games.

The boy and girl feel the rising tides of strength and vigor, and imagine that they have even more strength and endurance than the adult. But they are still far from the toughness of later years, when the tissues have gradually matured and hardened. Every commander of an army has recognized the high rates of sickness and death among young recruits during hard campaigns, especially in unhealthy and severe foreign climates. Now the hard bed with light coverings in the cool or cold room, and the cold bath followed by a few moments of vigorous exercise and hard rubbing will help the toughening process in the healthy boy. A less severe but similar regimen would remove the hot-house delicacy of some of our girls. But the hardening process should be most carefully and watchfully managed in those who need it most, and the advice of a wise physician may be invaluable in many cases. The danger from overpressure in study is probably not so great as in lower grades. The same laws of growth and development still apply. The athletic brain, like athletic muscles, is best attained by frequent periods of vigorous exercise alternating with those of rest. Still the girl should be allowed to change her position, and call the blood from the loaded brain to the cold hands and feet. Both boy and girl will study better for filling their lungs with cool fresh air every hour or so.

The greatest danger is from too much and too intense social life. Excitement is always fatiguing, if not exhausting, to the young. The late hours and loss of sleep rob the body of strength even faster than severe study. Whether the last years of the high-school course are too crowded for the best and most healthy mental development of our boys and girls is a quite different question. This can be answered only by experienced observers.

The attainment of full growth and of large muscular power, the large heart and lungs, the well oxygenated blood driven at high pressure, the activity and young vitality of all the tissues and organs, give buoyancy and courage, a sense of power and a longing for entire freedom, a revolt against control. A new world has opened before the boy as fresh and fair as on the morning of creation. The joy of mere living dawns upon him. He looks out upon a fair new life boundless in opportunity and endless in scope and time. He sees parents and teachers plodding in a humdrum round. He hears their criticisms or complaints. He is sure that they cannot understand him, and that they know very little of the glories of life and of this exceedingly good world. He is right to a certain extent. Young adults usually have the poorest opinion of life and the world. They furnish the reformers and the pessimists. This is perhaps unavoidable, possibly useful. But when with the boy we must overflow with hope and courage.

He will gird his loins and go whither he will. He must taste of every experience for himself, and is willing to meet both joy and sorrow with "frolic welcome." He would eat of the tree of knowledge of good and evil, though it should cost him paradise. He has not yet been saddened by experience or disillusioned by failure and disappointment.

Nature is now loosing her leading-strings. She is setting him free to complete his peculiar individual development, and to forge his own character. We cannot stop him if we would, we should not if we could. In old times the adolescent ran away to sea, now we send him to school and college. Here, beyond the reach of well-meaning neighbors and friends, he tries the experiment of life; makes his blunders; experiences success and failure, joy and sorrow; finds himself, his strength and weakness; and grows into a man.

Authority has only a superficial hold upon him, tradition far less. Only the influences of home-training, which have rooted themselves deep in his subconscious life, are still powerful. He has not yet gained self-knowledge or self-control. Much of the child still lingers in him. Impulses well up from every change in his physical constitution or condition; he knows not whence they come or how to meet them. He does not know his real strength, much less his weakness. He is very loyal to his associates, as is shown by his group games, his class or society feeling, and his school or college spirit. He cannot stand alone. Individual judgment and conscience are developing very slowly. To understand him and his actions under certain conditions you must have studied the psychology of the mob. Instability often seems to be his most marked characteristic.

He is a mixture of contradictions, an enigma to himself and to us. He might well say: "My name is Legion, for we are many." In the ferment of young life all that is trifling and worthless comes to the surface, the strong and sweet lie beneath the froth. We may very easily do him injustice. If we cannot understand him and sympathize with him, if we have totally forgotten our own experiments and blunders, we should send him to those who can do so or leave him to Nature. Forty years ago the Union was saved by an army of boys.

His conceptions of the meaning and value of time are hardly clearer than those of a child. He cannot play a waiting game. If the sun shines to-day, it will always remain cloudless; if the maid of his adoration has frowned, she will never smile again. He lives on the Delectable Mountains or in the depths of the Valley of Humiliation, more frequently in the latter region than we suspect. He betrays all his conceit, and cannot help it; his humiliation over his blunders, failures, and sins, he keeps to himself. Nature puts a shell around the chicken embryo to keep out intruders during the period of embryonic development. She puts a similar shell around the boy during this epoch in his development. He becomes reticent. He will not and cannot share his thoughts with us; that confidence is reserved for friends of his own age. It is on the whole best that it should be so to a large extent. Our clumsy fingers might spoil the process. He must fight his own battles. We must respect his reticence.

Let us look a little deeper. The boy is loyal to his friends, often generous to a fault. It is the epoch of the reign, not of cold judgment, but of feeling and of the heart, "out of which are the issues of life." Paul places love, with faith and hope, far above knowledge; which " vanisheth away, for we know in part." Perhaps Paul was right, after all. The heart is often fully as wise as the head. Feelings are racial, the results of generations or ages of natural selection and survival of the fittest, while opinions are individual and but of a day. Do not undervalue or curb too closely his generous impulses. The world will teach him selfishness fast enough.

He has a strange and crude system of ethics, apparently a survival of some remote period of barbarous life. But he is usually true to it. Make the most of all the good there is in it, and the imperfect and uncouth will in time be outgrown and disappear. Deal honestly and squarely with him, and the harder you apply curb or spur the better he will like you in the end. But "be strong and of good courage"; it is not a time for half measures. He is searching for a leader, and usually, like St. Christopher, he will follow the strongest. But even this crude desire will in time lead him to his king.

Tides of religious thought and tendency sweep through his soul. The first may have come at twelve or even earlier, and is often weak and sometimes seems to pass without permanent effect. A second frequently follows at fourteen, stronger but largely emotional. The wave at sixteen or somewhat later moves feeling, intellect, and will. Or his religious growth and development may be slow, gradual, and steady, with no marked crises. We must take advantage of the tides, and be watchful after every ebb. We may probably be more grateful for the slow and steady growth. But in whatever mode or form the growth comes, it is the most important change in his life. Nothing else can so steady him through this period of instability and cause it to result in a strong character.

The only religion which will appeal to him is one of heroism, endurance, and of powerful, lofty, and masterful personality. His king must be presented to his mind as stronger as well as better than he, and as altogether worthy of his unswerving loyalty, obedience, and service. He will have no other.

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The mental metamorphosis at adolescence is just as profound as the physical at puberty. All things are becoming new. His thoughts and conceptions, standpoints and views, judgments and inferences, all the attainments of childhood are resolved and crystallize anew. The form which they now assume will probably be permanent. It must be a time of instability, of surprises, and of contradictions. Perhaps you see only the beginnings of the process. But the preparation and beginning largely determine the final result.

It is the period of promise in the life of the boy and girl. It is often our privilege to catch a glimpse of these promises afar off, before they are suspected by parents or friends. Youth is a period of seeing visions and of dreaming dreams. There are endless possibilities in these dim visions. Mr. Phillips said that the power which hurled slavery from its throne was young men dreaming dreams by patriots' graves. I imagine that he would have acknowledged that a few living patriots might vivify the dream without disturbing it. The all-important question now is, Can the promise be made good, and the visions realized, or will they fade and disappear, leaving him a philistine or something worse? The dream has now more substance and value than all the rules of prosody, propositions of mathematics, or facts of anatomy.

Socrates said that his business was that of a midwife to bring great ideas to birth. Adolescence is the second birth, when the real man is born into the world. The business of the teacher is to bring to birth high aims and ideals, strong purposes, a vigorous spiritual life. To some these phrases may sound obsolete. They are hard to define, and harder of realization. But if there is any high-school teacher who cannot feel that they have any power and substance, to whom they are altogether meaningless or hazy, there is one thing for him to do. Let him retire to some great institution of learning, write a very large book on some useless subject, as far as possible from life. He may win renown as a lecturer at some great university. He is not big and deep enough to teach in a college or high school. These are institutions of power as well as of learning. They must be like fertile Phthia, "mothers of heroes."

The formal education of most boys and girls ends with the high school. Now he parts with his teachers. They must send him out into life with a powerful impetus toward all that is grand and lofty and difficult in art, literature, science, morals, and religion. Where one pupil goes to college five or ten will go directly into life. The high school is, and must be, essentially the people's college. It prepares the boy for life. The boy and girl are asking us: What is this great world and glorious life? What are its meaning and laws? How can I prepare for it? What opportunities must I seize vigorously and at once? What are the great dangers which await me? They are really asking for bread without which their hungry souls will dwindle and starve. If we respond merely with rules of prosody, problems of mathematics and dead facts of science, it seems to me that we are giving them a stone, or at best very dry and innutritious husks. The time for the mere memorizing of rules, with little or no regard for the absence or presence of any vital content, is past, provided it ever was. The over-exercise of the memory now clogs instead of stimulating the mind. The boy and girl are eager to think and discover concerning the most important problems of life.

Much depends upon the subject, but more upon the aim and method of the teacher. Classical literature and ancient history teem with life and vitality. But much of our drill and routine is admirably fitted to completely sterilize them. "Beauty," said Plato, "is the splendor of truth." We have no right to rob truth of its splendor. Even mathematics and modern languages are alive when taught by some teachers. Nature-study once consisted largely in counting the number of joints in the legs or antennae of a dead grasshopper. It is not wonderful that nature-study of that sort was neither interesting nor profitable. There are other methods in other studies which are equally dead and deadening, and which might advantageously be buried. If our knowledge is to stick and be remembered, it must in some way be made easy of assimilation to the little hoard of knowledge of life which our pupils are accumulating with all the greed of a miser. I fear that our system of education is not as wise as their instinctive craving. And the high-school teacher is by no means a "sinner above all the dwellers in Jerusalem."

Whatever be the subject, our teachers will gain greatly by forgetting, as far as possible, that bane of education, the entrance examination for college. After all possible arguments in its defense, it still remains true that this examination is the strongest possible incentive to the memorizing of words, rules, exceptions, and other disconnected facts. The cramming process is the foe of genuine thinking. The colleges and universities have wisely broadened the field of studies which will prepare for entrance. They will broaden it still more. The amount of material which must be learned or surveyed as a preparation may be, and probably is, larger than the schools can handle in the time at their disposal consistently with the best mental growth and discipline. A smaller amount, more thoroughly studied and thought out, would very probably give better results. Knowledge is the food of the mind. The chief question is, not how much we can consume and cause to disappear, but how much and how thoroughly we can digest and assimilate. But these questions also belong to experts. By experts we mean men of experience.

The colleges are fast learning that they may well trust the method of preparation to those who have had experience with young and immature minds, and that there is no one course of study which is best for all. The captains of athletic teams have learned that one athlete might be trained on the farm, and another in a city gymnasium. The chief question is, Has the young man the stuff and the power in him? not, How or where did he get it? The high school in the East will enjoy all the freedom of those in the West, possibly even more. It will frame its own course of study, suited to the needs of the overwhelming majority of its own students. It will train and develop according to the dictates of experience, not merely and entirely according to the best theories based on the psychology of the adult mind. The aim of the training will no longer be merely the largest possible amount of learning and intellectual discipline, but growth and development of all the powers, grasp, and efficiency, a large and full life. When they have attained these, learning will come almost of itself. Thus the high school will accomplish its chief end and purpose; and the college will receive stronger, keener, more vigorous and earnest, better developed and hence better prepared students. This change is coming fast, and is steadily gaining momentum. It will go far to solve the question why so many fail or do not care to reach the high school. It will draw to the teaching profession the young blood and enthusiasm, the brawn and brain, the power and efficiency, which are so much needed.

Perhaps we are teaching literature: some great poem, or thrilling oration, or a description of matchless power and beauty. We can make it our first aim to have our pupils look up every reference. They will learn much botany, archaeology, astronomy, and other useful and useless bits of information, which they will probably commit to their note-books and promptly forget. In my younger days we used Milton's "Paradise Lost" as material for the study of analysis. "Complex adverbial modifiers" of various classes infest our day no longer, but our aversion to Milton did not lose its hold so easily. It never seemed quite fair to Milton to use his grand poem for such a purpose, although I believe that his reputation has not suffered greatly from the abuse. But it harmed us all, and robbed some of us of our birthright.

We can show our classes the times and conditions under which a poem arose. They will learn a certain amount of history, which may be very valuable. We may teach them to paraphrase the poem, and they may gain a little power and fluency in the use of English words and phrases from its mangled remains. The so-called translation of Latin or Greek often amounts to much the same thing. After translation the thought and soul are frequently lost somewhere between Heaven and Hell, probably somewhat nearer the latter than the former.

The rule of the zoölogist, that the animal should be observed and studied alive as carefully and thoroughly as possible before you kill and dissect it, holds good in literature also. The pupils should feel some of the movement, power, and life of the poem before they proceed to destroy all this by their dissection, analysis, and rules of prosody and grammar. We wish, first of all, that they should enter into its spirit, find in it an inspiration which they cannot analyze or express, discover a beauty and a "light which never was on sea or land." They may not understand it; it is enough if they have felt it. The power and beauty have penetrated far deeper than the intellect, they have seized upon the imagination, won the heart, interfused and transfigured the whole being. Now we are teaching literature.

The eye is the window of the intellect, but the ear is the doorway to the heart and soul. Do we make enough use of this method of approach in studies which ought to lift and inspire? A passage familiar to the eye often comes to us with new and marvelous power or beauty, when read sympathetically by another. English was intended to be a spoken as well as a written language.

In thus teaching literature we have done something far better than merely to give literary instruction. We have awakened a new and life-giving interest which otherwise would have remained dormant and have died. In teaching children we had to follow their interests very largely, but we can lead and inspire the adolescent to share our best enthusiasms. The enthusiasm or interest may be immortal while the instruction is usually soon forgotten. All the information which we can give will soon be crowded out of the mind by the cares, thoughts, and pursuits of adult life. But the pupil who has felt the power and beauty of one grand poem will never again be quite content with poor and low literature. Some of them will demand the very best. But if Milton's lines are only material for analysis, and Homer is only a peg for rules of grammar, where is the inspiration to come in?

We have neither time nor place to consider other studies and branches of education. The methods and courses of the high school of to-day are vastly better than they were or could be twenty-five years ago. But even now in the effort to give abundant instruction are we not laying too little emphasis on the supreme importance of awakening new and lasting interests, inspirations, and enthusiasms?

Is even the development of a literary, historic, or scientific taste the chief end of the high school? Is there something still higher, better suited to adolescent needs? I believe that we will agree that the greatest human need is complete devotion to the highest moral and religious ideals; and that character is formed early, at least in tendency. It usually does not change essentially after the youth is twenty years old. It will improve, grow, and strengthen; but the growth will be along lines already marked. In one word character is formed in the high school, and this is its period of most rapid development.

Whoever wishes to develop a strong character must go deeper than the intellect, must mould the feelings and reach the will. We must arouse purpose as well as enthusiasm. Somehow we must train the unstable boy and girl to steadfastness and perseverance, to self-control, to prolonged and effective effort. This is the essential, crucial, and often baffling, problem of the teacher in the high school and during the first years in college. We work in the dark, and have few or no means of judging of the degree of success or failure attending our efforts. Another's will is not our province, and we enter it only by permission or unnoticed. Forcible invasion and conquest are out of the question. Will training is exceedingly slow and difficult, and requires inexhaustible faith and patience, as well as sympathy, insight, and skill. Yet somehow we must solve the problem.

You can form character through literature. You cannot spend an evening with charming Miss Esther Summerson or with fine old Colonel Newcome, and not be kindlier and more courteous, more brave and enduring. We can make history a dreary chronicle of dates and battles, or through it we can introduce our pupils to the heroes of all the ages. We can make it another eleventh chapter of Hebrews. If we tell of Gideon and Barak, of Washington and Lincoln, of prophets, apostles, and martyrs; if we saturate our pupils with the character of such men and women, have we not already trained a race of heroes? We are to see to it that the ideal does not become the object of a mere idle sentimental worship, but the goal of strenuous and long-continued effort.

We must therefore keep before them the example of men and women who, through much tribulation, have realized their ideals. Says Mr. Martineau, "We shall never have a proper system of education until we have a properly written 'Lives of the Saints.'"

We must train our boys and girls to walk the streets and to live in the world's Prytaneum with heroes and heroines. Can we not find an hour somewhere in the course to read to them Plato's "Apology" or the "Crito"? Let them sit with Socrates in his prison and listen to his discourse until the voice of the Laws "rings in their ears like the clang of the cymbals of the Corybants, and they can hear nothing else." Let them return once more and watch the sun sink over against the same prison and hear the last words of the old hero and sage as he bids his follower not fail to offer the sacrifice of thanksgiving due to the god of healing. We can not only awaken a new interest, we can arouse a higher life.

This power of arousing the divine life immanent in every human soul is the essential characteristic and criterion of every great teacher, prophet, and moral leader of all time. Read Alcibiades' tribute to the teaching of Socrates. Its seat is in the depths of personality; it defies alike analysis and resistance. It leaps from soul to soul as if by contagion. Heroism evoked by hero-worship is the central thought of all history from Gideon and his three hundred to Sheridan at Winchester changing a fleeing mob into an army of heroes. Virtue streams out from strong characters like electricity from a dynamo. Character cannot be taught, but it is exceedingly infectious; and good is more infectious than evil. If we amount to anything, we are sources of infection whether we will or not.

Hence courses, training, methods, and instruction all together are of far less importance than the personality of the teacher. The "everlasting miracle" which Kipling's Sergeant What-is-name worked when "He drilled a black man white, he made a mummy fight,"[1] is the final secret and essence of education. The chief use of school and college is to bring pupil and teacher near enough together so that the miracle will work itself. If we teachers are good for anything, we are putting into our pupils something better than our life-blood. We must be healthy in mind and body, or we cannot be strong; and strength streams only from the strong. We must be sympathetic, for sympathy is the cable along which the magnetic power of personality flows. With children we must be a child, and a boy with the boys. Otherwise the bond is broken or never formed.

We must be patient, hopeful, and courageous, else the child or man will not trust us, and will have none of us. Evidently we must catch this personality from some one else, and can transmit only what we have received. No one of us is quite big enough to fill the place assigned to him. Hence a teacher who does not believe with all her heart in the communion of saints will never be a real educator, however much Greek or History she may know, or however firm and wise her discipline. We must live in constant association with the best and noblest souls. We can easily find them among our immediate neighbors, if we search aright; if not, we must seek them in literature and history. We must gain admittance to what Heine has called "the apostolic succession of great souls, the only people who understand anything in the world." And we must change into their image. We are called to the very grandest of all professions. We cannot be sufficiently proud of our calling, or sufficiently humbled by the smallness of our attainments or accomplishments. We make the state or commonwealth of the twentieth century. We are doing something still bigger and better. We work for the development of the race. We mould it into conformity with what is deepest and most permanent in environment. Hence all the powers of Nature are with us. We cast in our efforts with the irresistible tide of events as it sweeps on toward a better age. Let us " be strong and of a very good courage."

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[1] "Pharaoh and the Sergeant," *McClure's Magazine*, vol. ix.

CHAPTER XIV

PHYSICAL TRAINING — THE PLACE OF PLAY IN EDUCATION

GROWTH is periodic and by parts. Each organ and system has a stage when growth and development depend upon exercise. This is true of different parts of the brain as well as of other organs. We have seen that our business is to discover what organ is growing rapidly and most needs exercise at each epoch, and to give that organ the kind and amount of exercise which it needs. The need is manifested by a craving or interest, which is as natural, physiological, and reliable, as hunger or thirst.

The foundation of a house must be laid before the superstructure can be added. Nature cannot build the complex human body by allowing all organs to grow equally fast at all times. Growth and development are successive, and follow a physiological sequence. Each system or part has its own period of acceleration. Even in infancy the vital visceral organs are sufficiently mature to provide nourishment and oxygen and to remove waste. Infancy and early childhood are their period of most rapid growth, and belong mainly to them. But even in the young child the heavy muscles are evidently maturing and crave exercise. The child runs, jumps, romps, and throws the ball. The use of these heavy muscles reacts upon heart, lungs, and all the internal organs, and stimulates their growth and development. Thus the muscles are our main reliance for insuring a healthy adult life. The kindergarten stage is characterized partly by sensory development, partly by the use of the heavier muscles. The period from six to ten is predominantly a motor period. The child's mental interests are still comparatively few and feeble. He is learning the uses of things. But inference and critical judgment, and the power to classify, do not appear until later.

These are the full years preceding the lean years of rapid growth in height and of the pubertal metamorphosis. We should use them to the utmost to store up material, strength, and vitality against this greatest crisis of life. All else can be deferred, but puberty hastens on relentlessly. Still even this crisis can be delayed somewhat and to the great advantage of the child, by sufficient open air and muscular exercise and by the avoidance of undue nervous stimulation and excitement. The more we can thus delay the crisis, the safer the passage, and the more satisfactory the issue. This is especially true of the girl, whose development is precocious and hurried. During the earlier years of school life physical training gives a very large return. And these are the years when the lack of mental interests suggests to us the futility of any large amount of book-study.

The pubertal period is characterized by a very rapid growth in height and by readjustment or rebuilding of all the organs of the body. This results in a large amount of waste which threatens to poison the blood, depress the nervous system, and to lower the tone of vitality throughout the body. Hence the rise of morbidity, and the appearance of anæmia with all its evil results especially noticeable in the girl, but only less marked in the boy. Every one of these symptoms or conditions is a crying demand for more oxygen through a larger capacity of the lungs. This can be attained through muscular exercise and only in this way. Physical training seems to be at least as necessary here as in the lower grades.

Even during adolescence the tissues must be matured and hardened against the rise of morbidity about eighteen and the accompanying increased death-rate. There seems to be no year in the life of the child or youth when physical training is not absolutely essential for one purpose or another. The results of sedentary indoor life show its need in the adult.

All exercise, whether physical or mental, must be given in moderate doses frequently repeated, if it is to have its largest and best effects. We eat three times a day, and the child can safely eat oftener. We have a succession of recitations five days in the week. Can we expect the best results from physical training required only two half-hours in the week, or left for the child to pick up for himself or neglect Saturdays and Wednesday afternoons? It is urged continually that we need not provide physical training for children and youth in the school. They have the hours after school for that purpose. But is it certain that the boy who most needs the exercise will take it? Is the girl sure to spend this time in the open air, and not to be needed for home duties?

It is frequently said that the school is for study, and that the home should provide the physical training. But if the school is designed to insure the training and education which is essential at each epoch, the lower grades might well devote their time almost exclusively to physical exercise and leave the book-study to be cared for at home. Strong arguments could be adduced for this view. But both extremes are to be avoided. There is room for both kinds of training in the school.

The muscles react directly or indirectly upon the brain as well as upon heart and lungs. An easily exhausted body means a brain incapable of strong or prolonged effort. Poor blood betrays itself in poverty or dullness of thought and in a lack of clearness of expression as well as of complexion. Who knows how far the freshness and vigor of the best English thought and expression are due to their sports and outdoor life? During puberty, and probably at all epochs, the brighter pupils have the larger lung capacity. Many girls are reprimanded for lack of application, and finally conditioned in their studies during the grammar-school years because of dullness due largely or entirely to their physical condition and insufficient lung capacity. This is cruelty. We should strike at the root of the difficulty instead of treating the symptom. The buoyancy and hopefulness of youth accompany the rise in blood-pressure. Courage, vitality, and the temperature of the body sink together during the hours before dawn. The tides of religious feeling are at their flood at fourteen and sixteen when the girths and the lung capacity have their accelerated increase. These are but a few illustrations of the fact that the condition of the body is reflected by the brain.

But this is not all. Many of the most valuable mental qualities and powers are best attained through muscular exercise. Accuracy of thought and expression is secured through accuracy of observation required for precise action. The will is trained most easily and effectively through muscular effort, especially during the years of immaturity of the tissues of the higher centres of the brain. Even the intellectual centres are matured in the same way. The process of medullation of the fibres and of maturing of the cells of the association areas proceeds centripetally from their edges inward. The parts adjoining the sensory and motor areas are the first to become medullated.

Hence the subject of physical training demands our most careful attention. In some schools the department has already won the place which belongs to it. It is most highly prized where it has been most carefully and thoroughly tried. There is still difference of opinion as to methods and forms. More careful study and experiment will doubtless greatly increase its efficiency. Defects remain to be remedied. But even in very simple forms it may be exceedingly useful.

It has many kinds and forms. We can consider only two of them: Play and Gymnastics. Manual training is allied to these, but is quite different in aim and scope. One or two other forms may be of almost or quite equal importance. The school-garden has come to stay. The country school-house with its mullein stalks and sumachs, a dreary building in a waste and cheerless land, will soon be a thing of the past. With our wealth of hardy and beautiful trees, shrubs, vines, and flowers, it can and will be made a joy to the eyes of all observers and an example to the community. This work has already been accomplished in many places. It is sad that so many country children have been accustomed mainly to ugliness during so many hours of every day of their most impressible years. In spite of prophecies to the contrary the city has demonstrated the possibility of such gardens, and the country is realizing their necessity.

We can best consider first the value of Play in education. This is the form of exercise which most appeals to young children; which is easiest, most natural, and most useful in the earlier grades; and which forms the foundation for other exercises.

No one can deny that the child's impulse to play is instinctive. The young of the higher vertebrates play also. Dr. Gulick [1] has called attention to the fact that play is practically the whole education of the animal; and that the adult intelligence of any species is foreshadowed in the complexity of the play-life of the young; and, finally, that the character of the play has a definite relation to the life-activities of the adult. An instinct of so wide range and power among animals should be of great importance in man.

The origin of the instinct has been variously explained. Play is activity for its own sake. The playing animal or child seeks no other reason. Some have regarded it as a means of working off superfluous energy; others, as exercise to promote growth; still others as a preliminary practice, a rehearsal, as it were, of the activities which are essential to adult life. There is probably truth in every one of these explanations.

Evidently the motions, speech, and all the actions of the baby are a form of play. The random movements may be a relief from restlessness through the discharge of energy continually accumulating in the cells. But all the time the baby is discovering himself, his parts, and his powers. He seems to be greatly interested in all his discoveries, as he well may be.

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[1] "Psychological, Pedagogical, and Religious Aspects of Group Games," *Ped. Sem.* vol. vi.

He begins very early to be interested in simple toys, especially in those which will make a noise. He examines them repeatedly and carefully with eyes, hands, and mouth. His plays are largely sensory; and with the dominance of the sensory powers two other powers arise which are of great importance in life. These are imagination and imitation.

Imagination and sensation are very closely related. When, before the dawn of judgment, sensations so largely occupy the mind, imagination has free scope and is exceedingly vivid. The child often fails altogether to distinguish between the real and the imagined. Hence the enjoyment of simple toys and playthings far exceeds that drawn from the complex machines often given to children. They are, as Jastrow has said, "lay figures on which the child's imagination can weave and drape its fancies." Fairy stories delight the young child. But they must always be told in the same words, else they do not fit the pictures associated with them in the child's mind. The value of this power cannot be overestimated. Without it the scientific man cannot plan his experiments, nor the inventor his machine. History is a dreary chronicle unless the writer has seen the events clearly and vividly, and lived in the times which he describes.

For the same reason the child is imitative. The actions and speech of those about him make a strong impression on his mind, and the impression manifests itself in action. Usually the imitation is vivified by imagination, and the child becomes for the time being minister or teacher, carpenter, doctor, or conductor. Thus he plays himself into a knowledge of the world, and into likeness to his elders.

Sensation, imagination, and imitation mingle in very varying amounts in the plays of different children. They may use the same toys, but the play will vary according as the child is imaginative, imitative, or sensory and matter of fact. Even at this period different children require quite different training. We are just beginning to appreciate the importance of imitation in education and in adult life. All these important powers are developing rapidly and gaining exercise while the child is playing with his blocks or at the sand-pile. With or soon after these exercises come the attempts at self-expression, which we might almost call manifestations of a creative instinct. This is shown in the child's drawings, paper-cutting, building, and other amusements.

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The child's movements are steadily increasing in number and complexity. Early movements are those of the fundamental muscles which become reflex and form the foundation for and beginnings of all the complex actions of adult life. So running, walking, handling, and the use of the body. Only when these have been thoroughly mastered can the brain proceed to higher and more complex activities. All these plays are individualistic.

Gulick and Burk both agree in these general conclusions. Burk[1] finds that the spontaneous plays of kindergarten children involve the use of the heavy muscles mainly of the legs. They involve no intense effort, precision or skill. About fifty-one per cent of the plays were by individuals, twenty-six per cent by groups of two or three, and twenty-three per cent by larger groups. The spontaneous play of this epoch is "unorganized, non-competitive, and non-coöperative."

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[1] *The Study of the Kindergarten Problem.*

A second group of plays prevails between seven and twelve. These, according to Dr. Gulick,[1] are social but competitive. Boys and girls play in groups, but every one usually plays for himself. Tag and other running games are the earliest. Throwing games are popular. Boys "stump" one another to difficult feats. The movements are more complicated and demand skill. Hunting and fishing are great delights. Predatory instincts begin to appear. These are the traditional, racial games, all based on the same instincts and needs, but varying greatly among different peoples. They represent the life-occupations of the highest mammals below man: chase, battle, etc. The instincts of the player are still animal rather than distinctively human. They depend, as a rule, upon muscular power and knack more than upon strategy or even skill.

After twelve, or thereabout, a third class of games appears; baseball, basketball, football, etc. They are group games played with sides. They are markedly coöperative, and demand the subordination of the individual. "Team-work" is the key-word. Sacrifice-hits are demanded. The games are complex and highly organized. Methods, aims, ends, and rules are fixed and definite. The most complex and precise movements are required. Strength and endurance are tested. Mere technical skill and knack no longer suffice. The higher mental powers play a larger part. This is but a brief condensation of Dr. Gulick's excellent analysis of the plays and games at different epochs.

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[1] "Psychological, Pedagogical, and Religious Aspects of Group Games," *Ped. Sem.* vol. vi.

We are chiefly interested in the coöperative and competitive games played between seven and twelve. Tag, hide-and-seek, and other running games are earliest. Ball soon follows. Our question is, Is the educational value of these games sufficient to justify giving them a regular place in the school curriculum during these years?

We will consider first their hygienic value. Running and throwing games involve the use of the heavier muscles. They exercise the largest amount of muscular tissue with the smallest expenditure of nervous energy. In the use of the finer muscles, in drawing, writing, and fencing, the reverse is true. The games are suited to the condition and stage of development of the nervous system. They exercise and stimulate growth in its most stable and fundamental portions, and fortify it against all forms of nervous weakness and disease. We have already seen that the use of so much muscle exercises and stimulates heart, lungs, and all the viscera, and promotes a healthy growth. If one organ, for instance the heart or the lungs, is undersized or weak, it has to work the hardest to meet the requirements of the body, and receives the largest share of the exercise. It is stimulated to grow faster, and thus overtakes the rest. There is little danger of overstrain; for, when the weakest part has had exercise enough, the child tires and plays more quietly or drops out. He can do this easily, for usually there are no fixed sides. Thus the weaker part is made as strong as the others, and the body gains a symmetrical development.

No game is usually played for a very long time. Soon all tire and rest, or a new game is started, exercising new muscles and nervous centres.

This growth and equalization of all parts of the body, resulting in a symmetrical development, is the essential part of education at this epoch. Furthermore, in all children's games periods of physical activity alternate frequently with periods of rest. There is little half-hearted dawdling. This is the ideal method of exercise.

If you watch a young child play, you are amused by the number, variety, and vigor of movements. Many of these give good exercise, but are a complete waste of energy as far as the result of the game is concerned. Gradually, as he plays more, he learns to suppress these, to economize and concentrate energy. This is one of the earliest and best lessons in self-control. It is a slow growth. But the poise and repose of the trained athlete are as admirable as his strength. All his life long he saves the energy which others waste in fidgeting and fretting. He is a shrewd investor, not a spendthrift, of his great power.

Play furnishes the very best mental training. Watch even a game of tag. The sense-organs are all alert. The attention is focused on one point. This is the best means of training the will, for close attention to one thing is one of the best forms of will-power. The child must "size up" the situation, and grasp the opportunity once and for all. He cannot "stand shivering on the brink of action," as the adult so frequently does. Thinking, willing, and doing are united, not separated. The same movement is repeated until perfected, and with undiminished interest. The child forgets himself, and loses shyness and self-consciousness in the game. As he grows older, the opportunity for skill, thought, plan, and strategy constantly increases. On the play-ground he learns far more than the rudiments of the science of success in life.

Here he must act on his own initiative. There is no one to tell him always just what to do, or more frequently what not to do. He is placed more nearly in the position of the farmer's boy, who had to help himself out of every emergency as best he could. The greatest losses in our modern life and education lie along these lines.

The kindergarten child is gregarious, but hardly social. The sensory period is one of little coöperation or competition, hence it is a time of comparative peace. But the child in the primary and intermediate grades is learning to get on with his fellows. He is finding how much he can claim, and what he must yield ; and how to yield with good nature. This is no easy lesson in these days of small families and large indulgence. Yet it must be learned. There is no more pitiable object than the boy trained under tutors or in small classes when thrown among other boys in academy or college.

He is often handicapped throughout life by the loss of this early training. At no period is there so much friction and squabbling, and so many accusations of meanness and unfair play. The result of the experience is worth a thousand-fold more than it costs, even if the price is sometimes tears and bloodshed and a black eye. The difficulties prove the need of the training.

Here the boy and girl receive their first lessons in the grandest art or science of life, that of making many firm friendships. A wise clergyman once said that in the millennium, if not sooner, a man's success in life would be measured by the number of friends instead of the number of dollars which he had amassed. Friendships are made on the playground far more than at the desk. If he does not learn to make them now, he probably never will. It was the "twa who paddled in the burn" and "wandered o'er the brae" together, who formed the friendship which weary wanderings and wide seas could not break. We parents usually do not help the child enough in this most important branch of his education, and we should encourage far more than we do his democratic tendencies.

The conception of fair and unfair play is almost the first genuine and spontaneous moral distinction which the child makes. He is still very hazy in his ideas of rights of property, and is anything but clear in his theories as to the necessity of truthfulness. But he is sure that the boy who cheats is mean and low, which is his definition of total depravity. If this germ of morality is fostered as it may be, it will bud and blossom in a whole system of individual, social, and civic righteousness. It has marvelous vitality and possibilities. But if you despise or neglect it, if you attempt to replace it by your own adult system of ethics, what happens? The boy and girl lose faith in their own conceptions of morality; they can neither understand nor appreciate your adult ethics; they are left without any system which appeals to them; their last state is worse than their first. Indeed they have fallen from a comparatively high estate. Fair play is at this stage more important than grace of deportment. Grace will in time follow strength.

Play is the best form and kind of physical training because it gives the most enjoyment. The chat and social pleasures accompanying a good dinner increase our powers of digestion. The enjoyment of a lesson or study fixes it in our minds, as well as inspires to further effort. So joy in exercise promotes growth as really as sunlight does. The work from which the play element is absent can never be of the highest order. Art is like play in that it is its own reward. Opportunity is an even higher and larger word than duty; and opportunities must be enjoyed. We should dignify play by our attention, study, and approval. Especially the girl needs to form such habits of play and other forms of physical exercise that she will not outgrow them when she lengthens her skirts.

The Puritan in his righteous protest against the follies of a frivolous court went to the extreme of trying very hard to despise play. He succeeded in making himself and all his neighbors thoroughly uncomfortable. He frowned upon leisure, which Aristotle considered the end of work. Some of his descendants inveigh against the kindergarten, and forbid following the natural interests of the child. It is a relic of the ancient, and not yet fully outgrown, opinion, that Nature is essentially evil. They used to say: "Hold the child's nose to the grindstone." The result was usually a severe struggle, with much animosity, heat, and friction; which ended in painfully and slowly removing a useful if not ornamental appendage. What we need is not to crowd out play or its spirit, but somehow to get more of the enthusiasm and zest of the playground into the work.

The advantages of play are many and great, and we have by no means exhausted the list. But it may be urged that every moment during the session is needed for recitation or study. The hour of play seems to be more profitable than any recitation or study; and if it can be gained in no other way, some learning should be sacrificed to make place for it. But those who have had experience in half-time schools report that young children learn almost or quite as much during half a day as during a whole one. The introduction of outdoor and manual work in our truant and industrial schools has not diminished the amount of knowledge acquired, but rather increased it. The children are more industrious, as well as amenable and contented.

Much of the book-work might well be postponed until the brain is somewhat more mature. The study introduced before the child can appreciate it becomes an object of indifference or more probably of aversion when it might be enjoyed a year later. The work would be done later in less time, and with far less effort. The disciplinary value of most studies as a means of stimulating growth of the brain is very small at this age.

Every teacher knows how few boys and girls grow up with good habits of study and powers of application. The colleges and universities criticise the preparatory schools for this defect, and the teachers of each grade report that the habit has been acquired and fixed in some lower one. Hence some logical sages lay the blame on the kindergarten system.

The cause seems to lie in the lack of powers of application, and here the remedy must be applied. The child in the primary or intermediate grade cannot and ought not to be required to exercise the immature centres of thought continuously for any long time. Probably one hour of mental work each day furnishes more exercise than the brain requires or can use profit-ably. He spends this amount of time in class-work, and returns to his seat. In many of our schools one young woman or mere girl has thirty or forty pupils in one room. They must be kept quiet, or disorder and anarchy will prevail. The child is given desk-work, or is told to take his book and study. Every muscle in his body is tingling and twitching for the exercise which it sadly needs, while the brain has neither need nor use for further exercise. But he must sit still. The problem which he has to solve is really this: How to forget his discomfort, and to remain quiet and to pretend to look at his book, and not do any mental work. He looks out of the window all he dares, and thinks about outside things the rest of the time. Now and then he reads a little in his book and moves his lips. But heart and thought are far away. When he has kept up this practice for two or three years, genuine study has become quite impossible. He has formed habits of dawdling and inattention. He will find it very hard to break or change these habits. The teacher is not to blame. It is wonderful that she can do as well as she does. The child is certainly not to blame. It would harm him to keep his brain active throughout the session. The system is responsible.

We seem to have taken it for granted that if an adult can apply himself for several hours to the work of class and study, the child can do the same. We are in danger of forgetting that the frequent interruption and change which spoil adult work are exactly what the child most needs. Send him out of doors until the muscles have had the exercise which they need. Then he will return ready to apply himself vigorously to his books for a short time. A few moments of vigorous application at any one time are enough. The result of repeating this alternation day after day would be habits of close application. We have no right to expect endurance from the brain tissues of the child. As he grows older the study periods may be lengthened. But we shall surely gain our best results by making them too short rather than too long.

It is certainly a misfortune that the plaything or game is always a reward, and the book very rarely so. We gladly recognize the great improvement already made in this respect, but something still remains to be done. Says shrewd old John Locke:

"If he [the child] be ordered every day to whip his top so long as to make him sufficiently weary, do you not think that he will apply himself with eagerness to his book, and wish for it, if you promise it him as a reward of having whipped his Top lustily, quite out all the time that is set him? Children, in the things they do, if they comport with their age, find little difference so they may be doing: The Esteem they have for one thing above another they borrow from others; so that what those about them make to be a reward to them will really be so. By this art it is in their Governor's choice whether *Scotch-hoppers* shall reward their *Dancing*, or *Dancing* their *Scotch-hoppers;* whether peg-top or reading; playing at Trap or studying the Globes shall be more acceptable and pleasing to them; all that they desire being to be busy, and busy as they imagine in things of their own choice, and which they receive as favors from their Parents or others for whom they have respect and with whom they would be in Credit. A set of children thus ordered and kept from the ill example of others, would all of them, I suppose, with as much earnestness and delight learn to read, write, and what else one would have them, as others do their ordinary plays.[1]

"Thus Children may be cozened into a Knowledge of the Letters; be taught to read without perceiving it to be anything but a sport, and play themselves into that which others are whipped for. Children should not have anything like work or serious laid on them; neither their Minds nor Bodies will bear it; it injures their Healths; and their being forced and tied down to their Books in an age at enmity with all such restraint has, I doubt not, been the reason, why a great many have hated books and learning all their lives after. 'T is like a surfeit, that leaves an Aversion behind not to be removed."[2]

"Play," said Colonel Parker, "is God's method of teaching children how to work." "The plays of children," says Froebel, "are the germinal leaves of all later life." Some one has expressed the same thought somewhat less elegantly, saying: "The boy without a play-ground is father to the man without a job." Without play life is stunted, and few of its possibilities are realized. Great men, as Yoder has shown, usually played hard and well in their childhood. The English nation recognizes how much it owes to the national games. Other nations are fast learning to recognize the value of this characteristic of English education. A more eloquent plea for games and plays can hardly be found than in Burgerstein's and Netolitzky's "Handbuch der Schulhygiene." The place of play in the curriculum has been recognized in some, at least, of the German schools, and we must remember that Germany is the home of gymnastics, and hence has less need of play. The same is true of some, or perhaps many, of our American schools. The proper length and frequency of these play-periods must be determined by the experiments of teachers and superintendents. Their amount and distribution will probably differ in different localities according to needs and conditions. The best results require that play should occupy fixed times, and that it should alternate with class-work. A little consideration will convince any one that these advantages cannot be gained by dismissing the smaller children a half-hour earlier, and sending them to their homes. But even this is better than a longer confinement.

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[1] Locke, *Thoughts concerning Education*, par. 129.

[2] *Ibid.* par. 149.

No small advantage from this change would be that the teacher would be compelled to spend a certain amount of time each day in the open air, and would be tempted, at least, to take some active exercise. The muscles of the teacher need exercise as much as those of the child.

The question of athletics in the high school is not a purely physiological problem, and we can hardly more than glance at that aspect of it. The group games of adolescence have great value. They strengthen and harden muscles, and test endurance. "Head-work" is necessary. The player must be keen to see the strong and weak points of his supporters and opponents, and quick to take advantage of them. He must have patience, courage, and self-control; loyalty and obedience to his captain. He must subordinate his own interests to those of the team. He learns to play an uphill or losing game, and to smile in the face of discouragement or defeat. If overstrain of the weak heart is avoided, school athletics may be made exceedingly useful. Many of the worst evils of athletics in our larger institutions are not likely to occur in high schools. A larger scope for athletics during these earlier years would probably lead to a more moderate and temperate enjoyment of them afterward. Inoculation often lessens the virulence of disease.

CHAPTER XV

PHYSICAL TRAINING — GYMNASTICS

The need of gymnastics is almost universally recognized. But different communities and nations assign it a very different value compared with that of other branches. In the German system of education it holds a very important place. We are only beginning to appreciate that our own children need it even more than the German. Its value seems to be far better and more generally appreciated than that of play, hence our discussion of the subject can be briefer.

Play is activity for its own sake. Gymnastic exercises have an ulterior purpose, to develop, strengthen, or otherwise modify some organ of the body. Hence the same activity may at the same time take the form of play or of gymnastics. The boy enjoys running games, but finds that he cannot run as fast or as far as his mates. He practices running to increase his speed or endurance. Now his running has become a gymnastic exercise.

We enter upon a course of gymnastic training because we recognize the need of strengthening some weak organ of the body; or others notice the need and prescribe it for us. Gymnastics are possible without a gymnasium, and many free gymnastic exercises are performed without any apparatus. Gymnastics require careful and wise supervision. The boy turned loose in a gymnasium naturally uses his strongest muscles. Such exercises are easiest, give him the most pleasure, and allow him to show his superiority. He neglects the exercise which will strengthen his weakest parts. The result is that his arms, shoulders, or legs become developed beyond the rest of his body. This is frequently noticeable in athletes addicted to the use of bar or trapeze.

The aim of our modern system of gymnastics is not to produce prodigies of strength, or to enable men to perform difficult feats, but to give an harmonious development. This requires a wise teacher and a patient, persevering pupil. Here is one difficulty of gymnastics: to make them as attractive and enjoyable as play, and thus to give the most enthusiastic and vigorous exercise. The pupil who has little zest or interest gains but a small part of the possible benefit. Some one has said: "Play is food, gymnastics are medicine." But gymnastics are necessary as well as play. First of all, it is impossible in our larger cities to find playgrounds adequate to the needs of the great multitudes of children. In severe weather outdoor play is difficult or impossible. Time is often an important element. During the recess some of the smaller and weaker children who most need the exercise do not join in the games. As the boy and girl grow older, they may cease to play, and spend their free hours moping over books. Hence for many gymnastics are absolutely essential.

Even the child who plays vigorously and freely needs gymnastic training also. For he plays longest and most frequently the games in which he excels, and neglects the weaker muscles. Much of this danger can be avoided on the playground by careful and wise supervision. But even this rarely goes to the very root of the difficulty.

A clumsy or ungraceful movement is always a sign of injudicious or wrong use of muscles. Few men and women walk or run gracefully. For this art we rely on the gymnastics of the dancing-class.

In selecting a system of gymnastics we must often impose upon the child movements or actions which he would not choose for himself. Hence we must be careful in our choice of exercises. What the child instinctively chooses will almost certainly be of some or considerable benefit to him. What we choose for him may do him harm. What is good at one period of life may be harmful at another. Running is hardly to be encouraged after middle life, nor feats of endurance in early youth. When gymnasia first came into use the narrow-chested boy was allowed to exercise on the parallel bars to broaden his chest. Later it was asserted that this exercise most strengthened the muscles which pull the shoulders forward, and that pulling the weights was much better for such cases. In selecting an exercise or system of exercises we must think very carefully just what we wish to accomplish, and then observe sharply whether the exercise is producing the desired results. The exercise must be suited in character, quantity, and quality to the age and needs of the pupil.

Exercises may be classified as to quantity as gentle, moderate, or violent. When gymnastics were first introduced, every one supposed that exercises which required a severe effort would give the greatest amount of strength. It was soon discovered that the muscles developed far more rapidly with very light clubs or dumb-bells. These stimulated nerve and muscles sufficiently, caused a rapid circulation of the blood, and promoted growth without causing exhaustion or too great destruction of material or tissue. The little girl skipping rope lifts her body several inches perhaps one hundred times in a minute. If she keeps it up for five minutes she has lifted her body over one hundred and fifty feet, a large amount of work. She does a little at a time and repeats it frequently.

A second classification mentioned by Lagrange is of interest to us. He divides exercise into three groups according as they promote strength, speed, or endurance. The same exercise which will promote speed may or may not promote endurance.

We are considering exercise in its relation to the growth and development of the child. We cannot expect that any one of these three qualities will be highly developed during childhood or early youth. We must regard exercise more in its hygienic aspects. We have already noticed that some movements require very little nervous expenditure, while others are more exhausting to the nervous than to the muscular system. Thus fencing and very complicated evolutions in marching require the closest attention and are nervous even more than muscular exercises. The exercises of the child during school hours should be largely recreative, though not entirely so. Very complicated marching evolutions, difficult and precise movements of hands and arms may furnish little relief to the fatigue of study. Yet these may be very valuable in their time and place. On the other hand, mere automatic exercises, which can be performed without thinking about them, may not sufficiently divert the girl in school or college who is preparing for a difficult examination. Here complicated movements may be better, and the frolic of play the best use of the time. Once again, the play must be suited to the age, condition, and needs of the pupil. No iron-clad system can always meet new needs, changes, and emergencies.

Many exercises which increase chest-girth do so largely by increasing the muscles of the chest; thus, parallel bars and chest weights. As Lagrange says, lung capacity must be increased mainly from within. Hence the advantages not only of running, swimming, and bicycling, but of singing and shouting. Ordinary light exercises in high altitudes often markedly increase the capacity of the lungs and thus the girth of the chest. The child with narrow chest and small lungs is often disinclined to join in active play or to take the exercise which he sadly needs. The condition of such children may grow worse instead of better, and they fall a prey to consumption or sink in invalidism. Here gymnastics are an invaluable and necessary corrective. Anything which prevents free breathing, like adenoid growths, hypertrophy of the tonsils, or catarrh, hinders the full expansion of the lungs and prevents their full development. Here, of course, the physical trainer needs the help of the physician.

The skin of the child or man who keeps in perfect physical condition is firm and fresh, the eye is bright and clear, the tissues are hard and firm. There is every appearance of strength and vitality. Even fatigue, as Treves says, brings no pain to him, but a full enjoyment of rest, by which he is refreshed and made ready for the joy of further activity. The improved physical condition is apparent in the carriage. Awkwardness of movement is usually a sign of lack of coördination of the muscles, sometimes of ill-developed joints. The muscles are not under the perfect control which exacts from each the amount and kind of action suited to the movement. They oppose and hamper one another to an abnormal extent. The seat of the difficulty is usually in the nervous system, but the remedy must be applied through the muscles.

A proper system of gymnastics trains the child or youth to perform each movement properly in its turn. It begins with the simplest and ends with the most complex. Only those muscles which are needed for the action are used, the others are not allowed to interfere. The action is repeated until it is performed automatically. This results in great economy and saving of muscular and still more of nervous energy; and waste of nervous energy is the worst of all dissipations. Everything is done with apparent ease, and this is the first element of grace of action and movement.

The same control gives endurance. The consciousness of vigor and power gives courage, calmness, and zest in difficult undertakings. It saves the continual output of effort, which always involves an expenditure of energy disproportionate to the results. We rarely do anything well until we do it easily and joyfully. All normal activity gives pleasure.

Hence in the stress and strain of adult life the well-trained athlete has a great advantage. He feels himself equal to each new task, and finishes it well without hurry or fret. He knows that he can carry the burden of the day, and wastes no energy in worry. His calmness and courage help all his fellows. At the end of the day he has not expended nearly as much nervous energy, and still has accomplished far more than the weaker man who has been fidgeting and worrying a large part of the time.

Only such a man can really enjoy life. Only he can understand the meaning of President Eliot's expression, the "enjoyment of work." He has reduced the labor of life to a minimum, even work is largely play to him. It is not too much to say that such a man has doubled his reserve of strength and halved his expenditure.

Such strong, healthy men and women, overflowing with vitality and strength, attract us. We like to work with them. They remind us of the figures in Claude Lorraine's pictures of a land where the hardest work is done with such ease and evident enjoyment that we wish to share in it. It is no wonder that we choose them for our leaders. Their faith, courage, and confidence are exceedingly infectious. We cannot help feeling that they are what we would and ought to be.

The man with disordered liver, poor digestive and assimilative powers, small lungs, or weak heart, which seem at perpetual war with one another, or with a nervous system as fussy and spasmodic as a gasoline engine, all explosion, noise, and noisomeness, — such a man is fit only to stay in the house, "a jest to all his foes, and to his friends a fear." For him there can be little rest or comfort until he "sleeps with his fathers." This condition should be impossible with a proper system of hygienic, developmental, and corrective gymnastics. Is not such a system or branch of education the best possible investment of a part of the funds of city and state? Economy along this line is surely "penny wise, and pound foolish."

But a proper system of gymnastics will only slowly find its way into many of our schools. The larger cities have realized its absolute necessity. But many or most of our smaller towns are slow to appreciate its importance. Can the teacher do anything to temporarily mitigate the evil of its neglect in schools and grades where it is most needed? She can respectfully urge upon the superintendent the need of frequent pauses between the recitations in addition to a recess of reasonable length. Usually this is unnecessary, for the superintendent is usually more eager for such an arrangement than the teacher. The pauses should be utilized to the utmost. In fair weather the children can be driven out of doors, and told to run and play vigorously. Meanwhile the windows can be opened and the room thoroughly ventilated. If for any reason it is impracticable to clear the room, some of the windows can be opened. The children can stand in the aisles between the desks and there be taught to practice vigorously a few simple arm movements. Dr. Sargent gives a great variety of these, some of which may well be selected. Deep breathing may be practiced at the same time. The number and range of the movements can be gradually increased in spite of the hindrance to free motion caused by the desks. This requires time, practice, and training.

If this be done twice or more a day, it will at least remove the strain and cramp of continual sitting. It will call the blood from the congested brain to the cold hands and feet. During the other pauses the pupils may walk and chat, and thus gain rest and change. Such exercise will cost a few moments every day. But it will more than pay for the shortening of the recitations by the greater mental alertness and vigor of the pupils. The only disadvantage of this proceeding is that many will claim that this slight mitigation of evil is all the physical training that the child needs. It is better than nothing, but not good enough to become an enemy of the best.

Every school should have its record of measurements of each pupil. This need not be extensive nor require much time or expensive apparatus. There should be a card for each pupil, with name and date of birth at the top. It should have a few vertical columns for successive annual or semiannual dates of measurement, weight, height, and lung capacity. Chest-girth might well be added. There should also be a final column showing the number of days' absence caused by sickness. A space at the bottom of the card might be reserved for the eyesight and hearing of the child. The test for eyesight might well be nothing more than the ability to read print of a certain size at a certain distance. The only apparatus needed would be scales, a gauge for measuring height, and a spirometer. This would answer the needs of all the schools in a small town or village. The initial expense would be small and need not be repeated. The apparatus, with price-list and full directions for its use, is well described by Dr. Hastings in his excellent manual.[1]

The increase in weight and in lung capacity is an excellent basis for judgment of the vigor of the child. Rapid increase in height is usually accompanied by weakness and disorder, and prescribes care. Chest-girth is also a good criterion of vigor. The number of days' absence on account of sickness shows the tendencies of the child. The measurements should be compared with those given by Hastings for each age. Anything below his twenty-five per cent line should be considered very suspicious. If best a card could be given to each child falling below this line showing the amount and character of his deficiency. Boys are usually, and girls are sometimes, ambitious in this respect; and the deficiency would often be remedied by the child or by the directions of his parents. By the time the child had reached even the grammar grade the record would give a history of great value.

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[1] *Manual for Physical Measurements.*

Such measurements can be taken very rapidly, especially if some of the older pupils of the high school could write down the measures as called by the teachers. It would require hardly more time than that expended on any written test of mental proficiency. The moral effect upon teacher and pupil would be excellent. It would impress upon them the fact that a symmetrical physical development is worthy of attention and effort, and that its value is appreciated by the school. As the child passed from grade to grade, each teacher at the beginning of the year would know the condition and history of every child, and would be prepared to show leniency or firmness, and to give a few hygienic suggestions.

Such a record is not ideal in its fullness. It would be very incomplete. It is recommended as one which would give a large return for a very small expenditure of time and money, and which could easily be used by teachers in any small village. Other blank forms of greater extent and value are given by Dr. Hastings.

CHAPTER XVI

MANUAL TRAINING

PLAY and gymnastics are educational, in that they promote healthy growth and development, self-control, poise, steadiness, decision, courage. Manual training is, or may be made, hygienic, a means of promoting health and muscular power. For this purpose it is inferior to play or gymnastics. It is really almost as pure mental training as the study of books. President Eliot has well said: "The human mind pervades the body. It is not in the head, but it is all over the body; and when you train the hand, or the eye, or the ear, you train the mind." Governor Russell has said: "Manual training is mental training. In the skill of the artist's hand, in the methodical, accurate movement of the mechanic's arm, in the acute observation through the physician's eye or ear, there is always mind. Never admit that manual training is anything distinguished from, or in opposition to, mental training."

We have seen that in play and gymnastics some movements and actions are very largely muscular, demanding little supervision or control from the cerebrum. They are performed automatically. Others, like fencing, are exercises of the brain or of the nervous system even more than of the muscle. Nearly all movements of the leg become automatic. Our arms, and especially our hands, are more richly innervated from far higher and more complex centres: they are capable of far higher education. Their development during thousands of years has kept pace and step with development of intelligence. Hand and mind are Siamese twins. The hand was intended to be used as the servant of the planning mind. Their centres in the brain stand in the closest relation with the highest areas of thought. Thus anatomy teaches that manual exercise cannot fail to develop mental power.

The value of manual training as an aid to mental growth is now universally admitted. The experiments and observations of Dr. Wey upon the inmates of the New York State Reformatory are well known. The work was especially beneficial to those who were dull or deficient in simple arithmetic. "This defect," we are told, "can be entirely eradicated through manual processes, using tools as the agent of the cure." We are told further that this cure cannot be effected by the mere "indiscriminate tool manipulation"; that the work must be carefully planned and taught, and nothing accepted which falls short of being absolutely satisfactory. Of this class of inmates sixty per cent showed considerable or marked improvement under such training, while forty per cent remained unimproved. How many of these latter might have been improved if they had received the training earlier in life we have no means of knowing.

The reports of truant and reform schools, and of schools for defectives, are equally favorable, often enthusiastic. The testimony of superintendents and teachers in our best city schools is to the same effect. The system seems to benefit all classes, rich and poor, cultured and uncultivated. This is only what we might confidently expect. What better purely mental discipline can be imagined than the close observation and accurate perception, the judgment and planning, the coördination of hand, eye, and brain, involved in the simplest work with wood or iron, or even with cardboard.

Ask a teacher of science to give up laboratory work, and he will tell you that teaching is impossible without it. The student can learn the laws, read and memorize the descriptions of machines and experiments, and see these in the lectures. But this is not enough. The boy must try the experiment for himself. This fixes and concentrates the wandering thoughts, and deepens the impression. Anything practical and practicable is never clearly seen or really understood by the pupil until he has seen it and done it for himself. The laboratory method is being more and more extended, and applied to all studies. And manual training is becoming the means of applying the laboratory method to just as many school studies as possible. Already maps are not only drawn, but modeled in relief. Thus geography has its laboratory as well as chemistry. The breadth of the possible application of the laboratory method is only beginning to dawn upon us. When eye, hand, and brain all work together upon a problem, the result of the combined study is far more than three times as great as if any one of them works alone. We never have really seen an object until we have attempted to draw it; much less do we understand a process which we have never attempted to perform. Manual training should be the study not only of schoolbooks, but of all the activities of life, by the laboratory method.

Furthermore, the boy who recites a lesson in grammar or arithmetic "somewhere near right," is usually contented with his success. One word is as good as another to him, especially when the whole statement is meaningless. But one who makes a box, or even folds a paper, so that corners or edges are not true is laughed at by all his comrades. School sentiment condemns and ridicules poor manual work as it never will mistakes in recitation.

As this use of manual training is universally admitted, we can turn our attention to a second even greater advantage, some of whose aspects have not received the notice which they deserve. President Walker once said: "There was nothing in the old order [of education] which tended to direct and develop the executive faculty; the power, that is, of doing things as distinguished from thinking about them, talking about them, writing about them. No one familiar with the laws of mind will be disposed to deny that there is at least a tendency in the protracted study of any subject, apart from putting that study to a practical use, toward producing a partial paralysis of the will, shown in a disposition to procrastinate, to multiply distinctions, and to stand shivering on the brink of action. Finally, the school studies of that age gave no play to that constructive passion which is inherent in every healthy child's mind; — a passion so strong that it is readily perverted through lack of opportunity and exercise, into the passion for destruction, just as any good thing is susceptible of perversion into an agency of evil or mischief."

It may or may not be a disgrace to the scholar or learned man that he cannot realize his conceptions in action. It is certainly a great misfortune to him and to the public. And our schools and families should certainly aim to produce men and women of power and dexterity in action as well as in thought and logic. When men and women have become so busy in thinking and discussing, that they can no longer act and execute, the state is in great danger. The Athens where men "spent their time in nothing else but either to tell or to hear some new thing," was degenerate and senile; and not much later its schools of philosophy were closed because their vaporings were no longer worth hearing.

It has been said that one half of the food brought into our cities is wasted by the consumer by bad methods of preparation. A large percentage of the fuel used in our kitchens goes the same way. Good cooking would do more to prevent drinking among the laboring classes than all the chapters on temperance in our physiologies. In how many of the schools in our smaller country towns is cooking taught? Canned vegetables are sold in farming communities, if not to farmers. The school is not responsible for this state of affairs. But if school and parents can remedy the evil without any detriment to the intellectual development of the child, but rather with advantage, it certainly should do so.

The demand is continually arising from many quarters that our education should be made more practical. The word "practical" admits of many different shades of meaning. It may mean that far more emphasis should be laid in our schools on work which will prepare the boy and girl to earn a living. This is not an unreasonable demand if it does not interfere with teaching them how to live well also. If it means that the study which bears directly on the highest success in life is better than one which influences our life only very indirectly and remotely, the claim for the most practical education is certainly well founded.

In all our schools we devote many hours to anatomy, physiology, and hygiene. These studies are of the utmost importance, for they affect directly the welfare of every individual. But the lessons are almost always forgotten. They do not find anything in the child's mind or conscious needs to which they may attach themselves. The child in the cooking-class learns and sees and never forgets that bad food is unfit to eat and that well-prepared food is delicious. She soon finds that the study furnishes abundant opportunity for the most careful thought. It is a disciplinary study. Is it neglected in our country schools because it is not needed, or because most of us think that cooking is a business which requires little brains and that it would degrade the school to devote money, time, and energy to so base a pursuit? Work in the chemical laboratory is highly respected and appreciated. Is similar work in learning to properly prepare food so as to sustain and lengthen life any less honorable or beneficent? How many girls go from school to shop or store, and then marry, and proceed through their ignorance to destroy the stomachs of their children and to drive their husbands to drink? Poor teaching in language, mathematics, or history is a disgrace. But sewing and cooking can be omitted from the curriculum of the schools in our small towns and villages without a word of protest from anybody. Very similar questions could be asked about the course of study for the boy. Have we not a lurking prejudice that anything like cooking, gardening, carpentering, or any form of woodwork, which can be made of direct use in our daily life, ought on that account to be carefully kept out of our schools?

Even where manual training is provided, the boy or girl who expects to go to college has not time or opportunity for the study. When are these boys and girls to be taught to do something beside fumble over their books? Will they learn after they leave college, when their muscles have hardened and stiffened beyond all possibility of acquiring craftsmanship? Or is the home responsible for all this? Shall we ever respect these arts, sciences, and crafts until we dignify them by careful study and find how much opportunity for the keenest thought and most skillful action they continually afford? Does not our system of education tend to train boys and girls to be equally proud of their knowledge of Latin and of their ignorance of the necessary and grand work of daily life? Is not such training immoral?

We respect others for being able to do what we have studied and attempted, and admired, and have tried to do for ourselves and only partially succeeded. There is to-day a deplorable lack of respect for skill, ingenuity, and dexterity in manual work. Joy in work should be cultivated in every possible way. What the laborer needs and rightfully demands is not charity nor sympathy, but respect. Respect for skilled manual work will do more to destroy the hard feeling between classes and to maintain true democracy than all the fourth-of-July orations. Jules Ferry declared that the ennoblement of manual work was the great object of France in reorganizing her system; and that the only practical way to teach the nobility of manual work was to give it a place in the school itself. Now manual training is no cure-all for mental, moral, and social evils. If we expect the impossible from it, we will surely be disappointed, and then we will probably lay the blame on the study. Our question is, How much may we fairly and reasonably hope from it?

In our study of "interests" we noticed that children between seven and ten or eleven are greatly interested in trades and manual work. They wish to be carpenters, engineers, farmers, dressmakers, etc. They have at this age a strong instinct to do, make, and create. Real life appeals to them. This is one great advantage of the kindergarten, that the child is living a real life in an almost ideal community instead of preparing by study of dry abstractions for one which is so far away that it does not appeal to him. The child wishes to make something which will be of real use and service to contribute to the family. He wishes to help.

If this creative, executive, helping instinct is not gratified, the boy begins to lose interest in books and study, and profits little. The father thinks that he is wasting his time and gaining nothing. When he is twelve or thirteen, he is taken from the school and put into a shop or factory. This is the time when he should begin to appreciate his studies and to gain most from them. In the shop the boy no longer idles. He is interested, he has "waked up." Boys sent from the best city schools because of persistent truancy to truant schools where a liberal amount of manual and industrial training is given, become attentive and amenable to discipline, and sometimes improve so markedly that on their return they are promoted to a class higher than the one they left.

Such a boy, or almost any boy, is given the opportunity to do some handwork in the school. He is interested at once. It appeals to a natural instinct, as arithmetic and geography cannot do. He is set to making a box. The interest arouses his will as no external pressure could. He soon finds that he cannot finish it in a moment or an hour. It is a more complex and difficult matter than he had thought. He must "buckle down to it," make his preparations, measurements, calculations. This not only stimulates the will, but gives him the power of sustained effort, the greatest blessing to any boy or man. He finds that a mistake at any point in the preparation may spoil the whole work. He grows careful, looks ahead, takes pains. Is there any better training for giving him a strong and sound will, which is the foundation of all moral development? And is there any better mental training than his accurate, painstaking observation, calculation, and work? Making the box reminds him of something else which he would like to do, something finer or more difficult. He is roused to a new and greater effort, which results in mental growth and strength. He makes himself work, and enjoys it. You can, perhaps, make him work at his books. But as soon as the external pressure is removed, he ceases his efforts. You are really only putting moral shoulder-braces on him, which will leave him weaker than he was before, instead of strengthening his muscles. The results of manual training are of permanent value.

Very likely the boy is making the box for his father or mother. It is his first tangible contribution, perhaps, to the comfort and welfare of the family. The experience results in an appreciation of his own possible worth and usefulness, as well as in stronger love for his parents.

The boy who has some such training during five or six of the formative years of his life will never rest content with dreams and abstract concepts. The instinct to realize his conceptions and ideals will remain alive and powerful, instead of having aborted and died through lack of exercise. He will never see carpenter, blacksmith, or mechanic doing a fine piece of work without appreciating it, gaining enjoyment and giving pleasure at the same time. He will respect honest work and appreciate the effort which it requires. He will recognize shams, and flimsy and cheap products, and have little respect for idleness or incompetence. The grand cathedrals of Europe were reared by artisans who loved, and appreciated, and did, honest and fine work.

Manual training is most needed perhaps by the children of the well to do and cultured. But its results will be most and most quickly apparent in those of a different class. Mr. Adler tells us that children fall into one of two great classes. There are some who are quick with their books as we say, and who enjoy them. They learn words easily, and have a gift of using them. Then there are other boys to whom the book is a burden, and a composition or essay almost as much of a torment as it is to the teacher who has to correct it. Such a boy often finds it almost impossible to memorize the pages of lessons which are assigned to him. He will almost surely lose interest in school work of the ordinary kind. He is a trial to his teacher, who is tempted to consider him a dunce, and he grows hopeless and careless. He escapes from school as soon as he can.

Yet this boy will often do excellent work in drawing or modeling, in handling wood or iron. The fact that even he can do something well, or better than all the others, and thus win the praise of his teacher and parents and the respect of his comrades is a discovery of inestimable value to him. He can do one thing well and now he has some courage to attempt others. He has waked up, has "found himself," has discovered his possibilities. He becomes a new boy. He is no longer a detriment to the school and the worry of his teacher.

Such a boy, indeed nearly all boys, will accomplish more learning, if they devote a part of their time to manual training than if they spend the whole of the school hours poring or dreaming over their books.

Evidently one, if not the chief, purpose of education is to enable us to express clearly our best thoughts and conceptions. Grammar, composition, and some other studies are valuable mainly or entirely as they make us masters of the art of verbal expression. But thought and learning, personality and character still more, can be expressed far more effectively in deeds than in words. The painter of portraits or landscapes has his place as well as the biographer or poet. The practical inventor is needed at least as much as the scientific student or investigator. When the investigator can apply his results, his usefulness to society is more than doubled. The doer of the word is far more effective than the preacher or orator.

Why should not expression through handwork be as worthy of cultivation as rhetorical expression through words? If the child can be trained and become accustomed to express his thoughts in both ways rather than in one, will it not conduce to clearness and accuracy of perception and concept? Will it not develop and train that finest and highest power, the scientific imagination, which is often stunted or destroyed by our study of books and words?

Hence the best educators have always insisted on the principle of some such variety. Horace Mann said that if teachers would give one half of the school-hours to creating a desire to learn, more would be accomplished than by giving all the time to book-work. Froebel insisted on the importance of alternating study and work. Nowhere has this been more fully and advantageously emphasized than in Jewish education. Says the Talmud: "The study of the law without occupation of labor will finally be interrupted and end in sin." "The father who does not teach his child a trade brings him up to be a robber." Let us not forget that Spinoza made spectacles, and that Paul was a tent-maker. We must be careful not to confuse manual and industrial training. Each has its place. That any nation which is striving for the first place in art and commerce should fail to recognize the absolute necessity of both is almost incredible. Industrial training is for the boy or girl who has already decided to follow a life of manual or industrial work in some special craft or trade. Its tendency is toward specialization as really as is that of law or medicine. It is intended to aid the worker to the greatest success or proficiency in one line. Manual training is intended to develop the powers for any situation in life. Its effect is to broaden the mind and to open doors to new possibilities and careers. It is a valuable preparation for technical or industrial training, but equally beneficial to the man who will never handle a tool in after-life. Indeed the student needs it more than the artisan.

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It is equally useful to the girl, and perhaps she needs it even more than the boy. Female teachers are sometimes criticised because they do not feel, and hence cannot teach, the connection between the information of the daily lesson and life outside of the school. Hence their instruction is likely to be wordy and bookish. The criticism may be unfounded. But the education of our girls to-day leads us to fear that it may well be true. The most that the average girl learns of life during her school years is at most a little of the drudgery of housework. Home-making has never been sufficiently studied to be considered an art, much less a science. Of other forms and kinds of work the girl learns nothing. She cannot reasonably be expected to teach that of which she has never had any experience, or which she has never had the opportunity even to observe. As long as teaching remains practically mere instruction, it will be the only field open, and the most attractive, to those men and women who are totally devoid of actual, experimental knowledge of everyday life and work.

If this is true to any extent of our teachers it is probably true also of most girls who do not go into the normal school but to college, or who return home at the close of the high-school course. If her executive ability and power to plan a piece of work have never been tested or developed, if she has never even learned that work must be planned, she finds the cares of a household an exceedingly difficult problem, not to say a heavy burden. Now she must plan, calculate, administer, and direct. The great wonder is that the American girl succeeds as well as she does under circumstances for which her education and most of her home training have unfitted her. Here is a problem which taxes the most vigorous thought and keenest ingenuity of parents, teachers, and educators. If our lower grades, and most of the classes in the higher ones, are to be taught by young women, the problem must be solved, or the rising generation will suffer harm.

But manual training must be skillfully and wisely adapted to the age and abilities of the pupils. That which is exceedingly interesting to the child in kindergarten may prove stale and unprofitable to the grammar grade or even the primary class. The kindergarten teachers have solved their problem fairly well. It remains to discover by experiment and careful thought just what exercises will be most profitable in every higher grade. There would seem to be no reason why work in bending iron could not be widely introduced with much profit. Even the folding and pasting of paper so as to make various forms of solid geometry might be useful.

But the growing boy and girl demand more resistent material. Gardening may not be manual training in the exact sense of the word. But what it lacks in this direction is compensated by the æsthetic development and love of nature which it stimulates to so high a degree. Especially in our small country schools in poor neighborhoods the teacher may well venture now and then to try an experiment which seems to be suited to the needs of the community. If it does not realize her ideal, or satisfy all her wishes, it will be vastly better than nothing.

CHAPTER XVII

RETROSPECT AND SUMMARY

At the risk of some or much repetition we may now turn back and trace the general line of the results of our study of the physical growth and development of the child.

The strain of modern life makes it essential that we should fortify him far more to-day than was necessary one hundred or even fifty years ago. Perfect physical health is an absolute necessity. Unless every part is "of equal strength and in smooth working order," most of our vital energy is used to overcome internal resistance, or dissipates in fret and worry. We need all the buoyancy, courage, and hope which come from the consciousness of vigor. Health is impossible without a full development of all the vital organs: stomach, heart, and lungs, as well as brain.

We have seen that these vital visceral organs originated in response to the demands and stimuli of the developing muscular system, before mind and brain were on the throne. They can be developed only through physical exercise in hygienic surroundings. Health can be maintained by the adult only through vigorous muscular exercise in the open air. Much more is the same exercise essential to its attainment. The period when our internal organs most need such exercise, and best respond to it by healthy growth, extends through infancy and childhood.

Our brief study of embryology has taught us that during these earlier years we must heed and follow Nature's suggestions. The same is probably true of adult life as well, but here Nature's requirements are not always as clear and explicit.

Nature evidently requires of the infant and young child that it should grow as fast and as far as possible. Growth is the primary and chief essential. It should be made the chief business of these years, for without it development is impossible. This is so self-evident that we often forget it. A little more growth may, and often does, make all the difference between the average man and the leader of extraordinary physical, mental, and moral strength and ability. Every organ should be allowed time for its stage of pure growth, and should receive exercise only when it craves it, and not before. We must not attempt still further to hurry Nature when she is already hastening the process of development just as far as is safe. We allow the baby's legs to grow and gain strength before we permit or encourage him to walk. We should certainly be equally cautious and wise with the most complex and delicate portions of the child's brain. When the organ begins to crave exercise, we should furnish suitable kinds and amounts fitted to the stage of growth and development, and varied from year to year as maturity hastens on. To deny an exercise which the body craves and needs to-day, and substitute for this one which is suited to a later stage or to a different organ, involves both loss and harm.

The chief business of the educator viewed from this standpoint is to find the stage of growth and development of each organ at each year or epoch of life, and then to furnish the kinds and amounts of exercise which will best promote growth and development at that epoch. For certain organs during infancy we can do little more than make conditions favorable and remove hindrances and dangers. During the sensory epoch we will provide material and occupation to exercise the sense-organs. When the muscular crave exercise we will satisfy them, and thus promote their development and that of all the organs dependent upon them. When at ten or twelve the logical powers of thought and reasoning begin to betray their need of exercise through awakening interests and questions, we will follow them. We will not ask that the child should think or act as a man, or try to impose upon him methods or systems of training suited only to the adult body and mind. We will remember that his constitution undergoes marked changes at successive epochs of life.

If this reasoning is correct, and it seems to be only the dictate of the plainest common sense, always known but not fully recognized and realized, it is clear that physical development is the chief business of the young child both at school and at home. For few really mental interests appear until some years later. It is perhaps too much to ask that up to this age play should form the largest part of his school duties. It should certainly be given a large place, and its importance and value cannot easily be overestimated.

That some form of physical exercise is equally essential to the health and development of the boy and girl during the critical and all-important pubertal years is evident to any one who has made even a superficial study of this period. The high rate of morbidity due largely to the condition of the blood overloaded with the waste products of organic growth and readjustment, is proof positive of the need of abundant exercise in the open air. The rapid increase of vital capacity between the ages of nine and fourteen in girls who have gymnastics, as well as its small and irregular increase in the average girl, is a demonstration of her needs. When her future happiness, health, and usefulness depend upon her successful development and metamorphosis during these trying years of accelerated growth in height, is it too much to say that failure to satisfy this need of exercise is nothing less than criminal negligence? Even in the high school hygienic and developmental training are still needed to mature and harden the tissues. Still we must bear in mind and guard against the rising death-rate at nineteen and twenty, the final result of failure to pass Nature's examinations. The exercise must be adequate in quantity as well as in kind. Two half-hours in the week for all forms of physical exercise are a mockery of the child's needs. In many of our schools that which may possibly be a little better than nothing is often the worst foe of that which is good and right. It is not best to soothe our consciences when we are failing to do our clear and evident duty.

But some will possibly still maintain that all this is the duty of the home, and that the school is in no way responsible for the physical part of education. It is true that the home should do far more for the health and vigor than it is now doing. We parents are not sufficiently awake to our duties and responsibilities in this and in some other directions. But, especially during childhood, vigorous exercise is needed frequently and in small doses. The school session occupies more hours than the child should spend without frequent change of position and opportunity to change the direction of the circulation of the blood. This should often be drawn from the gorged brain to the hands and feet, especially during puberty. A short recess, often wasted in dawdling, is no sufficient relief. But this is not the most important reason for pleading for liberal physical exercise during school hours.

Fifty years ago three partners were responsible for the education of the child. These were the farm, the home, and the school. On the farm the child enjoyed an abundance of open air and of physical training suited to his age and needs. Every farm was a hive of manual training. Nature study was compulsory; school gardens were entirely unnecessary. Almost as soon as the child could walk he had his work and duties. These were no artificial exercises prepared with much thought and ingenuity. They came to him necessarily from the conditions of his life. He did a boy's work as soon as he could, and aspired to do that of a man. He was a partner in the household, his help was needed and had value; and he usually willingly accepted the responsibility. He learned to make his own toys or to go without them. He learned to meet new emergencies day by day. He was compelled to be self-reliant, resourceful, ingenious, as well as economical, industrious, patient, and persevering. The short term of study gave him a sufficient acquaintance with books so that he was always hungry for more. What he had learned during the three months of winter he remembered, reviewed, thought over, and assimilated during the remainder of the year. This system provided for a symmetrical physical and mental growth and development, and for gain in power and efficiency,

We hear much of the debt of our fathers to the "little red school-house," and the school deserves nearly all the good and some of the bad which has been said about it. But the debt of New England to the farm as a means of education has never been properly and sufficiently recognized. Many who owe most of their success to its hard training remember only its shadows and deprivations. Had farm life persisted, our present system and schools would meet the needs of the child fully and excellently. But this most advantageous partnership has been dissolved; and for the present, at least, we cannot hope to renew it. Even where the farm remains, the life and atmosphere, though beneficent, is not what it was one hundred years ago. Most of us live in towns or cities. Here it is almost impossible for us to find needed and useful manual work for our children to do. Many of the tasks which we assign are imposed artificially rather than a natural outgrowth of healthy and necessary conditions. The boy and girl have but a very small share in the duties and responsibilities of the household. Even these few duties are performed under the eyes and direction of the parent, and give little opportunity for initiative, resource, or ingenuity. Almost their only industry is study.

The diffusion of wealth has removed from many the spur of necessity, and has led them to think that the world owes them not only a living but the luxuries of life. Many expect to be fortunate enough some day to get something or a good deal for nothing. The new conditions, and some of the evil results, are not the fault of the parents. The loss of the opportunities furnished by the farm has greatly decreased the educational efficiency of the home. And the decrease is of a kind which most surely and directly affects the will and character of the child.

Of the three members of the original educational partnership, one has retired, a second has lost severely in efficiency through the withdrawal of the first, and the third remains with vastly increased burdens and responsibilities. But home and school must in some way compensate for the loss of the farm. Otherwise the next generation will surely fail to equal the record of the past, much less to surpass it. This work of compensation will tax all the powers of both home and school. They must work together and earnestly. Neither one can be allowed to throw its share of the new burden on the shoulders of the other. There is more than enough work for both.

Under these circumstances it is not strange that we hear criticisms of the results of our system of education. These are often too sweeping and severe. The child of to-day probably reads, spells, and ciphers as well as his grandfather could at his age. Some of us have forgotten the deficiencies and failures of our childhood. But when the business man complains that the boy of to-day is lacking in perseverance, resource, ingenuity, and efficiency, we have reason to fear that there is some ground for his complaint.

A teacher at a training-school said: "Give me country girls for my classes. They have red blood and will not balk." Such red-blooded pupils who are ready to grapple with any task or problem are already educated in some most important mental and moral respects. The presence of such pupils gives a tone and atmosphere to a class which cannot be spared. Yet is it fair to expect that the average town-bred pupil will show all these traits which are the product of totally different conditions during early life? Will the blood be as red in the child whose only duty is "to eat his meals" as in one who lives and works in the open air from one end of the day and year to the other?

The school year has already doubled or trebled in length, and more and better books and courses of study have been added. The course has certainly been greatly, perhaps too much, enriched. But all this increase of book-work and of learning does not meet the difficulty which we are considering; it probably increases it. Especially in the lower grades the child is kept over his books longer than he should be. We overexercise his brain, while we cramp his muscles. The result is that he learns to dislike books, and to form the worst possible habits of study. These habits often become so fixed as to be practically unchangeable. In the schools of many of our towns and cities the child is engaged in mental work nearly throughout the session; at least, he is supposed to be so busied. Yet often he acquires no more learning than the child who goes to school only one half the day. He probably learns much less than the average child would under the system of the industrial schools where outdoor work and manual training occupy a large part of the time.

He has almost no time to assimilate what he learns. He would be in great danger of mental dyspepsia from the cramming process, if he were not saved from this fate by speedily forgetting most of what he has acquired. If one third to one half of the time now devoted to book work were given to play, gymnastics, school-gardens, etc., the child would probably learn more than he does now. He would work with far less weariness and fatigue, and with far greater interest and enthusiasm.

The advantages to the mental powers of such a change through the increased physical stamina of the child are evident. We remember Schmid-Monnard's telling us that the growth of the German child is always lessened and sometimes completely arrested during the first year of school life. He emphasizes the danger to the youngest and most precocious children, and tells us that a larger proportion of these drop out by the way. When we arrest growth we strike at the root of all possible future development, as well as of power and efficiency. We can hardly appreciate the advantages which would result from replacing a system which hampers growth by one which favors and fosters it. Every ounce of strength and vitality gained during infancy and early childhood increases at compound interest during each successive year.

If we make the fullest possible use of the years between six and ten or eleven to store up material and strength against the pubertal metamorphosis, we insure the child against heavy loss at this trying period. Gilbert's observations lead us to suspect that the increase of the girl's lung capacity by suitable exercise during these years would far more than compensate for the time used in this way. The greater vigor and power of the well-oxygenated brain would more than make up for the loss of time. We do not know to what extent morbidity might be decreased. We know only that we should thus remove one of its most fruitful causes or occasions. And we know that at this time the ounce of prevention is worth many pounds of cure.

If we could bring our boys and girls into the high school in perfect physical condition, with interest unimpaired or increased, and with good habits of study, they could probably accomplish more than they do now and still have time for the manual training and gymnastics which are so much needed.

If manual and physical training are profitable to the average boy and girl, they are absolutely essential to the children of our business and professional classes, and to all those who have any congenital tendencies toward nervous weakness or disease. Such children are often of great mental promise, and should be saved and strengthened for the service of the community and the state. They are far more numerous than we suspect. Under the present system the school cannot possibly do all that it might and should to increase their physical, and thus their mental, stamina.

Thus far we have considered education only as a means of increasing learning. But this is its least important element. Physical and manual training would give a better and more complete discipline, and hence a more athletic mind. The best method of increasing muscular strength is by periods of active exercise alternating with those of rest or of complete change. An hour a day properly used in vigorous athletic exercise will produce a larger amount of stronger muscle than a half day's steady work sawing wood. The men who do the most hard and heavy work are not always the strongest. Frequently they are surpassed in strength and endurance by the athlete who has done less and lighter work, but who has thrown every ounce of will and vigor into the exercise. The same law applies to mental development. But the higher mental centres are far less mature during the years of rapid growth and are far more easily and quickly fatigued than the muscles. Hence we must be on our guard lest we overstrain them.

Once again let us remind ourselves that the right amount of mental as well as of physical exercise is not what the child can endure without evident fatigue, but what will be most profitable for the growth and further development of very immature tissues. The line of profit lies far within the line of fatigue, for it is not yet the time to train for endurance. And as the nervous tissues of the higher centres of the brain are far less mature and tough than those of the muscles, their periods of vigorous exercise should be made correspondingly shorter. This is a fact which teachers and parents alike are very prone to forget.

The adult student who trains and accustoms himself to spend as many hours as he can endure over his books or any form of mental work rarely gains as alert, fresh, and vigorous a mind as the man who expends the same amount of energy and effort in one half of the time. And the quality of the work of the athletic mind is always far higher. It has not the taint of the smell of midnight oil, not to say smoke. Hence periods of mental exercise of children should be shortened and interrupted by periods of rest and change even more than in physical gymnastics. We have already noticed the advantages of enjoyment and zest in work which come from change and variety.

During the last years of the high-school course the periods of mental work may well be lengthened. But even here it is better to cultivate habits of hard rather than of too prolonged study. The power of concentration and application is the highest attainment. If the periods of study are too long the student even in the high school will probably lose in concentration more than he can gain by the amount of work. Here the high-school teacher can learn much by studying the methods of the successful athletic trainer.

But the development of the will is surely more important than that of the intellect. This is the part of education which has suffered most from modern conditions, and any compensation which the school can make is certainly of the greatest importance and value. Will-power and muscle are closely associated and related; and, especially in the child, the will is most easily reached and strengthened through the muscles. Long before the brain is mature enough to receive anything but harm and loss from close or long application, the sturdier, heavy muscles may be held to a fair amount of steady and persistent effort. But the influence of physical and manual training upon the will has already been sufficiently emphasized in preceding chapters.

Changed conditions require that our schools should shift somewhat the emphasis in their statements as to the aim of education. Formerly the farm furnished the efficiency and power, the school the learning and the purely intellectual development. Now the school must make every effort to furnish both. It must inspire and arouse interest, must call forth purpose and ideal, but must develop also the strength and resolute perseverance to realize these. It must furnish power and ingenuity lest the adult balk at slight obstacles, or be discouraged by difficulties. To many it must try to compensate for the loss of the spur of necessity.

These latter qualities are hardly attainable merely and solely through the study of books. They are exercised and strengthened far more by the application through the muscles of what has been acquired and assimilated by the intellect. Hence the value of laboratory work and of manual training, which is or should be the laboratory of the science of everyday life. The attainment of efficiency through perseverance, exactness, and skill is of far more value than any amount of knowledge of rules of language and mathematics, or of facts of science; especially if these are committed to memory to-day against an examination to-morrow, and then immediately forgotten as foreign to any possible or probable experience.

A large proportion of our boys will depend for their livelihood upon some form of manual or physical work. Can we not show them the possibilities of such work, that it can be made an art or science worthy of universal admiration and pursuit? The interest of the child in handcraft and his respect and admiration for such work should at least be preserved and not destroyed.

I once asked a football captain about the condition and prospects of his team. He answered: "They know the rules of the game pretty well. What they need most is more pounds in the rush-line." I am not certain that our present system of education is yet giving the best instruction in the rules of the great game; but surely we cannot send our pupils out into life with too many pounds in the rush-line.

The advantages of changes leading to so worthy ends are well appreciated and fully understood by many of our teachers and by nearly all our superintendents. Our most progressive cities and towns have already made similar changes, and have proven that they are beneficial. In most localities the superintendent would gladly introduce manual and physical training, or increase the time now devoted to them, if the public would allow him to do so and then give him their cordial support in his efforts. The responsibility for holding to an inadequate system must lie finally with you and me, as long as we block the wheels of progress.

It must be confessed that the public does not seem to set a very high value on these branches of education. When, in a spasm of economy, we cut down the appropriations for our schools, the first teacher to be discharged is not one of the many instructors in language, but the one and only teacher of gymnastics. The next department to suffer is almost always that of manual training. If the tide of economy runs high, the teacher of music also is swept away. The Greeks considered physical training and music the most important branches of education. They certainly were intelligent as well as intellectual.

When the Committee of Ten framed their course of instruction for secondary education, I cannot find that they held any conference concerning physical training, nor do I find it mentioned in their report. They do not seem to have left much time or place for any one to crowd it into the grammar or high school. Yet that committee was composed of very wise and intelligent men. They failed to seize an opportunity to forward a most important movement, apparently on the ground that the subjects and disciplines form no natural and essential part of secondary education. Many of us follow their august example.

Few of us parents can spare much time to consider such subjects. We read the magazine articles on the latest discoveries in science or history. We skip any article on education which the editor in a careless moment has chanced to accept. We throng the hall to hear our member of Congress speak on the sacredness of the tariff, though the good man finds it somewhat difficult to become very eloquent or to touch our convictions, while he discusses the importance of protecting coal and iron and other infant industries. But should the superintendent of our schools wish to explain to us his plans and policy concerning the education of our children, he would have to speak to empty benches in most localities. The election of a president or governor calls out every vote. The election of a school-board responsible for the education of our children is a quite minor issue.

Our schools are of more importance than the enactments of Congress or of our Legislatures. A kind Providence has usually saved us from the worst results of legislative blunders, and we have no means of knowing how much good a few statesmen in Congress might be able to accomplish. Yet our deplorable neglect is not due to any lack of interest in our homes and children.

Conservatism weighs heavily with many. We have invested an immense amount of money, thought, and labor in our schools. These institutions are of great size, having thousands of pupils in even our smaller cities. We cannot change them and risk our vested interests to follow every whim and fad of eager experimenters and would-be reformers. Our teachers have been trained to certain methods and policies. It is neither wise nor fair to ask them to change all these for any uncertain advantage. We must be cautious and slow in our changes and experiments.

Yet in education as elsewhere the good is often the worst enemy of the best. We should remember that every educational system is necessarily more or less of an experiment; and that we must change, whether we will or not, to keep pace with changed conditions. Otherwise we shall surely fail to train our children to meet present dangers and emergencies and to grasp present opportunities. It is unjust as well as unwise to ask excellent teachers to work under a system which is antiquated and inadequate in important respects. But the American citizen is usually anything but over-conservative, when he has once seen the advantage of a change.

Those who are most interested in the cause of education are usually those who prize learning most highly. They watch with anxiety the growing interest in athletics in school and college. They believe that the physical well-being of the child will care for itself, but that sound learning will always need stanch and devoted defenders. The influence of such men has been the greatest help and blessing in the past and is needed still; but we may well question whether their zeal against physical training or their neglect of it is according to knowledge. The lower grades of our schools have not been invaded by athletics to any great extent. A little more athletics would certainly help our girls in these grades. Over-indulgence in academy or college, wherever occurring, may be due more to earlier denial of a natural and healthy craving than to any other cause. Apparently sound and profound learning would be best promoted to-day by attention to the soundness of the body during the earlier years of life.

The deepest source of the opposition, neglect, or lack of interest, seems to be the failure of most of us to realize that any system of education, however good in itself, can be adequate and ideal only in so far as it is suited to existing conditions or to our existing stage of social development. When old conditions pass away and new ones arise, the system of education must change front and tactics to meet the new dangers and emergencies. If "the old order passes," "one good custom may corrupt the world," as Tennyson tells us.

Those of us in middle life see that the schools of to-day are generally furnishing the education which would have been adequate to all our needs twoscore years ago. We wish to have our children have all the opportunities and training whose lack or imperfection we felt most deeply and remember most clearly. We forget that most of us were reared under conditions quite different from those now existing; and that our children's needs may not be the same as ours were. We easily forget how fully the school has carried out all these changes and reforms needed in our childhood; that the changes in the direction desired by us have already gone far beyond our former hopes, perhaps beyond what in moments of careful consideration we would approve.

While we clearly remember the deficiencies of the schools of our childhood, we are in danger of forgetting the advantages of our early home training. Many remember only the hardships and deprivations of their early life, and in their unwise fondness would not have their children share the training to which they owe their strength and success.

What may be urged fairly and wisely is a careful, thoughtful, patient consideration of the claims of the various forms of physical education; and that this consideration should be undertaken in the light of present social conditions and needs, and with an adequate knowledge of the present condition, work, and needs of our schools. The most progress has been made, and the best schools are found, where the public has been brought into the closest relation with the superintendent and the teachers. Every town and city needs an educational club to learn, appreciate, and support the policy and plans of the board and superintendent, as far as these are reasonable. The least that we can do is now and then to invite them to explain to us their aims and wishes, and to turn our most careful attention and thought to their recommendations. Unless we are willing to do this much, the best and most energetic superintendent can accomplish but little. Only as the public becomes sufficiently educated to appreciate the difficulty and complexity of the present educational problem, can it expect to vote or legislate wisely and thus secure the best returns on the investment.

It is becoming more and more difficult to draw any sharp line between the responsibility of the home and that of the school. The partnership of the two has become exceedingly close. Their interests are of course identical, and each shares in the work of the other. Their areas of duty overlap. The lower grades of the school are an extension of the home, and the home should aid in the work of the higher grades. As the inter-dependence of the two increases, the largest possible acquaintance between parents and teachers becomes absolutely essential. The teacher who knows us well will have far more charity for as well as knowledge of our children. When we appreciate the work and fidelity and difficulties of the teacher, we shall see more clearly how we can actively help and what hindrances we can remove. This better mutual understanding will pave the way for many improvements at home and at school. Both parties will be greatly benefited by the coöperation and sympathy.

APPENDIX

APPENDIX

A. TABLES

Table I gives the dimensions and proportions of the body and the principal internal organs at birth, at the end of each of the first five triennia, and in the adult. The first column, A, gives the absolute measure in kilograms or centimeters ; the second, B, the percentile increase during the preceding three years ; the third, C, the per cent of the adult measure attained at each age.

The American heights and weights are taken from Holt (138, p. 20), Boas (116, pp. 262, 263), and Hitchcock (96). The English heights and weights are from Roberts (134). The sitting-heights, and standing-heights as compared with the sitting are from Porter (118). The girths are taken from Quetelet (135), except those for boys older than six, which are from Hall (125). The strength of squeeze is copied from Hastings (124) ; the lifting-power from Weissenberg's "Sudrussische Juden." Weights of brain, liver, kidneys, and heart are from Vierordt (139, pp. 21–24).

Table I.

MALES.

Age.	WEIGHT.						HEIGHT.		
	American.			English.			American.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.
	Abs.	% inc.	% of ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	3.4		5.3	3.2		4.8	52.5		30.3
3	14.2	317.6	22.2	15.4	381.3	23.1	89.1	69.7	51.4
6	20.5	44.4	32.7	20.1	30.5	30.1	112.0	25.7	64.7
9	27.0	31.7	42.1	27.4	36.3	41.1	127.0	13.4	73.3
12	34.9	29.3	54.4	34.8	27.0	52.2	140.7	10.8	81.2
15	48.7	39.5	76.0	46.8	34.5	70.2	159.8	13.6	92.3
Ad.	64.1	30.9	100.0	66.7	42.5	100.0	173.2	8.4	100.0

Age.	HEIGHT — ENGLISH.			KILOG. PER METER WEIGHT.	SITTING-HEIGHT.		
	A.	B.	C.		A.	B.	C.
	Abs.	% inc.	% ad.		Abs.	% inc.	% ad.
0	49.5		28.8	6.5			
3	93.5	88.9	54.4	15.9			
6	111.8	19.6	65.1	18.4	61.3		67.4
9	126.2	12.9	73.5	21.3	66.7	8.8	73.4
12	139.7	10.7	81.3	24.8	72.6	8.8	79.9
15	158.0	13.8	92.0	30.5	79.7	9.8	87.7
Ad.	171.8	8.7	100.0	37.0	90.9	14.1	100.0

Age.	HIP TO CROWN.			HIP TO SOLE.			ARMPIT TO HIP.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	24.2		36.6	24.3		22.7	8.3		32.9
3	42.7	76.4	64.5	52.3	115.2	48.9	15.1	81.9	59.9
6	48.6	13.8	73.4	66.2	26.6	61.9	16.8	11.3	66.7
9	50.1	3.1	75.7	75.7	14.4	70.8	17.3	3.0	68.7
12	53.8	7.4	81.3	83.0	9.6	77.6	18.6	7.5	73.8
15	57.9	7.6	87.5	96.9	16.7	90.6	20.7	11.3	82.1
Ad.	66.2	14.3	100.0	106.9	10.3	100.0	25.2	21.7	100.0

Age.	STAND-HT. — SIT.-HT.			Ht. sitting. ÷ Ht. stand.	CHEST-GIRTH.			Chest girth. ÷ Stand.-ht.
	A.	B.	C.		A.	B.	C.	
	Abs.	% inc.	% ad.		Abs.	% inc.	% ad.	
0					34.2		36.8	65.1
3					51.1	49.4	55.0	57.4
6	47.6		58.8	56.3	59.1	15.7	63.6	52.8
9	57.7	21.2	71.3	53.7	63.9	8.1	68.8	50.2
12	65.6	13.7	81.1	52.5	68.8	7.7	74.1	49.8
15	75.2	14.6	93.0	51.5	76.6	11.3	82.5	49.4
Ad.	80.9	7.6	100.0	52.5	92.9	21.3	100.0	53.6

GIRTHS.

Age.	Thigh.			Upper Arm.			Forearm.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	13.8		26.3	9.1		29.6	7.5		28.1
3	26.5	92.9	50.5	13.5	45.1	44.0	10.1	34.7	37.8
6	29.8	12.5	56.8	14.5	7.4	47.2	10.7	5.9	40.1
9	37.1		70.7	18.7		60.9	17.6		65.9
12	41.0	10.5	78.1	21.3	13.9	69.4	20.1	14.2	75.3
15	46.1	12.4	87.8	25.5	19.7	83.1	23.7	17.9	88.8
Ad.	52.5	13.9	100.0	30.7	20.4	100.0	26.7	12.7	100.0

Age.	Squeeze.			Lift.			Lift ÷ Weight.	Squeeze ÷ Weight.
	A.	B.	C.	A.	B.	C.		
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	%	%
0								
3								
6	7.0		14.5				134.8	36.1
9	13.1	87.1	27.2				174.5	52.2
12	19.7	50.4	40.9	54.2		36.0	176.0	59.7
15	28.9	46.7	60.0	90.6	36.4	60.2	221.0	61.5
Ad.	48.2[1]	66.8	100.0	150.6	59.4	100.0	264.8	67.7

WEIGHT OF ORGANS.

Age.	Brain.			Liver.			Kidneys.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	381.0		25.6	141.7		7.8	23.3		7.6
3	1108.1	190.8	74.4	484.7	242.1	26.6	102.1	338.2	33.4
6	1359.1	22.7	91.2	614.8	27.5	33.8	106.8	4.6	34.9
9	1425.0	4.8	95.6	701.7	14.1	38.6	156.0	46.1	51.0
12	1415.6		95.0	880.0	11.2	48.4	(157.5)[2]	(1.0)	51.5
15	1490.2		100.0	1306.0	48.4	71.8	239.7	52.2	78.4
Ad.	(1490.2)		100.0	1819.0	39.3	100.0	305.9	27.6	100.0

[1] Hastings.

[2] Av. of 11 and 13.

Age.	HEART. A.	HEART. B.	HEART. C.	LUNG CAPACITY. A.	LUNG CAPACITY. B.	LUNG CAPACITY. C.	LUNG CAPACITY.	CO$_2$ PER HOUR AND KILOG. REL.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	% weight.	
0	23.6		7.9					
3	64.8	174.6	21.6					
6	84.9	31.0	28.2	.83		19.1	4.28	
9	108.3	27.6	36.0	1.33	60.2	30.6	5.30	210.
12	(152.5)	(40.8)	(50.7)	1.83	37.6	42.2	5.55	186.
15	199.4	(30.8)	66.3	2.64	44.3	60.8	5.62	165.
Ad.	300.6	50.8	100.0	4.34	64.4	100.0	6.96	130.[1]

[1] 100 = amount at 57.

WEIGHT.

FEMALES.

Age.	AMERICAN. A.	AMERICAN. B.	AMERICAN. C.	ENGLISH. A.	ENGLISH. B.	ENGLISH. C.	AMERICAN — HEIGHT. A.	AMERICAN — HEIGHT. B.	AMERICAN — HEIGHT. C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	3.3		6.1	3.1		5.6	52.2		32.5
3	13.6	312.1	25.3	14.3	361.3	25.9	89 1	70.7	55.4
6	19.7	44.9	36.7	18.9	32.2	34.2	110.0	23.5	68.5
9	26.0	32.0	48.4	25.1	32.8	45.5	126.2	14.7	78.5
12	35.7	37.3	66.5	34.7	38.2	62.9	142.5	12.9	88.7
16	48.4	35.6	90.1	48.2	38.9	87.3	156.5	9.8	97.4
Ad.	53.7	11.0	100.0	55.2	14.5	100.0	160.7	2.7	100.0

HEIGHTS.

Age.	ENGLISH. A.	ENGLISH. B.	ENGLISH. C.	WEIGHT ÷ HEIGHT.	SITTING-HEIGHT. A.	SITTING-HEIGHT. B.	SITTING-HEIGHT. C.
	Abs.	% inc.	% ad.	%	Abs.	% inc.	% ad.
0	49.0		30.6	6.3			
3	92 0	87.8	57.5	15.3			
6	109.0	18.5	68.1	17.9	59.5		69.9
9	123.7	13.5	77.3	20.6	66.2	11 3	77.8
12	141.5	14.4	88.4	25 1	72.7	9.8	85.4
15	154.7	9.3	96.6	30.9	81.4	12.0	95.7
Ad.	160.1	3.5	100.0	33.4	85.1	4.5	100.0

Age.	Stand.-Ht. — Sit.-Ht.			Sit. Ht. ÷ St. Ht.	Chest Girth.			Chest—Girth on ÷ Stand. H.
	A.	B.	C.		A.	B.	C.	
	Abs.	% inc.	% ad.	%	Abs.	% inc.	% ad.	
0					33.2		41.3	63.6
3					50.5	52.1	62.8	56.7
6	48.2		65.1	55.2	58.3	15.4	72.5	54.2
9	57.5	19.3	77.5	53.5	62.5	7.2	77.7	50.6
12	66.4	15.5	89.5	52.2	68.3	9.3	85.0	49.1
15	73.6	10.8	99.2	52.5	76.8	12.4	95.5	50.1
Ad.	74.2	0.8	100.0	53.4	80.4	4.7	100.0	50.6

GIRTHS.

Age.	Thigh Upper.			Thigh Lower.			Calf.			Upper Arm.		
	A.	B.	C.	A.	B.	C	A.	B.	C.	A.	B.	C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	13.7		27.4	11.6		31.3	9.7		29.2	9.0		34.2
3	26.2	91.2	52.4	21 6	86.2	58.2	17.9	84.5	53.9	13.4	48.9	51.0
6	29.3	11.8	58.6	23.6	9.3	63.6	20.4	14.0	61.4	14.3	6.7	54.4
9	32.4	10.6	64.8	25.7	8.9	69.3	22.6	10.8	68.1	15.6	9.1	59.3
12	36.4	12.3	72.8	28.2	9.7	76.0	24.7	9.3	74.4	17.0	9.0	64.6
15	42.1	15.7	84.2	31.8	12.8	85.7	27.8	12 6	83.7	19.3	13.5	73.4
Ad.	50.0	18.8	100.0	37.1	16.7	100.0	33.2	19.4	100.0	26.3	36.3	100.0

Age.	GIRTHS.						WEIGHTS.		
	Forearm.			Right Hand Squeeze.			Brain.		
	A.	B.	C.	.A	B.	C.	A.	B.	C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	7.4		50.3				384.2		28.6
3	10.0	35.1	68.0				1040.2	170.7	77.3
6	10.4	4.0	70.7	5.2		17.3	1264.5	21.6	94.0
9	11.3	8.7	76.9	10.1	94.2	33.6	1242.6		
12	12.2	8.0	83.0	16.0	58.4	53.2	1245.2		
15	13.5	10.7	91.8	24.4	52.5	81.1	1238.1		
Ad.	14.7	8.9	100.0	30.1	23.4	100.0	1345.0		100.0

WEIGHTS.

	Liver.			Kidneys.			Heart.		
Age.	A.	B.	C.	A.	B.	C.	A.	B.	C.
	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.	Abs.	% inc.	% ad.
0	164.0		10.7	23.1		8.6	24.0		9.5
3	445.0	171.3	29.0	99.3	329.9	36.9	59.7	148.8	23.7
6	642.0	44.3	41.9	129.3	30.2	48.0	89.2	49.4	35.3
9	795.0	23.8	51.9	133.3	3.1	49.5	123.3	38.2	48.9
12	807.9	16.2	52.7	(204.8)		76.1	(110.0)		
15	1420.0	75.8	92.7	235.0		87.3	250.1		99.1
Ad.	1532.3	7.9	100.0	269.2	14.6	100.0	252.4	0.9	100.0

	Vital Capacity				CO_2 per Hour and Kilog.
Age.	A.	B.	C.		
	Abs.	% inc.	% ad.	% Weight.	
0					
3					
6	.71		28.0	3.83	
9	1.14	60.6	44.9	4.58	0.850
12	1.54	35.1	60.6	4.65	0.743
15	2.02	31.2	79.5	4.33	0.562
Ad.	2.54	25.7	100.0	4.90	0.540

TABLE II.

DEATH-RATES AND SPECIFIC INTENSITY OF LIFE FOR EACH SEX IN BOSTON IN THE CENSUS YEARS 1875, 1885, AND 1890, TAKEN TOGETHER.

Age.	TOTAL NUMBER LIVING AT EACH AGE.			TOTAL NUMBER OF DEATHS AT EACH AGE.			DEATH-RATE PER 1000 LIVING AT EACH AGE.			SPECIFIC INTENSITY OF LIFE AT EACH AGE.			Age.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	
	M. and F.	F.	M.	M. and F.	F.	M.	M. and F.	F.	M.	M and F.	F.	M.	
0–1 Years	24,120	11,997	12,123	6,707	3,074	3,633	277.61	256.24	299.51	3.59	3.90	3.33	0–1 Years
1–2 "	17,173	8,411	7,762	2,060	989	1,071	119.95	117.58	137.98	8.33	8.50	7.24	1–2 "
2–3 "	25,543	12,671	12,872	960	469	491	37.58	37.01	38.14	26.60	27.01	26.01	2–3 "
3–4 "	23,811	11,894	11,917	611	295	316	25.66	24.80	26.51	38.97	40.31	37.71	3–4 "
4–5 "	21,854	10,809	11,045	462	233	229	21.14	21.55	20.73	47.30	46.39	48.23	4–5 "
5–6 "	22,236	11,127	11,109	348	183	165	15.65	16.44	14.85	63.89	60.80	67.32	5–6 "
6–7 "	20,794	10,428	10,366	289	150	139	13.89	14.38	13.40	71.95	69.52	74.57	6–7 "
7–8 "	20,756	10,283	10,473	197	99	98	9.49	9.62	9.35	105.36	103.86	106.85	7–8 "
8–9 "	20,385	10,226	10,169	145	83	62	7.11	8.11	6.09	140.58	123.20	164.01	8–9 "
9–10 "	19,960	9,978	9,982	125	51	74	6.26	5.11	7.41	159.68	195.49	134.89	9–10 "
10–11 "	20,585	10,325	10,260	103	54	49	5.00	5.23	4.77	199.11	191.20	209.38	10–11 "
11–12 "	18,601	9,271	9,330	*70*	*30*	40	*3.76*	*3.23*	4.28	*265.72*	*309.03*	233.25	11–12 "
12–13 "	20,375	10,219	10,156	79	44	*35*	3.87	4.30	*3.44*	257.91	232.04	*290.16*	12–13 "
13–14 "	18,871	9,560	9,311	98	59	39	5.19	6.17	4.18	192.55	162.03	238.74	13–14 "
14–15 "	20,390	10,112	10,278	100	59	41	4.90	5.83	3.98	203.90	171.39	250.68	14–15 "
15–16 "	19,776	10,180	9,596	111	60	51	5.61	5.89	5.31	172.10	169.66	188.15	15–16 "
16–17 "	20,824	10,798	10,026	137	71	66	6.57	6.57	6.58	152.00	152.08	151.90	16–17 "
17–18 "	20,612	10,824	9,788	149	86	63	7.22	7.94	6.43	138.33	125.86	155.36	17–18 "
18–19 "	23,025	10,650	10,375	218	80	108	9.46	6.32	10.40	105.61	158.12	96.06	18–19 "
19–20 "	22,840	12,206	10,634	237	128	109	10.37	10.48	10.25	96.36	95.35	97.55	19–20 "
20–21 "	25,431	14,817	10,614	222	103	119	8.72	6.95	11.21	114.55	137.73	89.10	20–21 "

Prepared by Dr. E. M. Hartwell, Bib. No. 250.

MORBIDITY.

Boys.				Girls.		
Copenhagen.		Stockholm.		Age at last birthday.	Denmark.	Sweden.
Age.	%	Age.	%		%	%
6.6	18.4[1]			6	23.0	
7.5	18.4[1]	7.8	17.6	7	27.0	28.6
8.5	34.0	8.9	36.7	8	28.0	50.0
9.6	30.7	10.0	33.8	9	39.0	47.6
10.5	33.6			10	40.0	55.7
11.7	33.5	11.3	34.4	11	39.0	59.7
12.5	32.8	12.3	37.6	12	42.0	64.8
13.5	41.9	13.4	38.0	13	50.0	64.4
14.3	31.8	14.3	37.4	14	48.0	63.1
15.6	28.3	15.4	36.6	15	40.0	63.9
16.7	38.2	16.5	34.7	16	40.0	62.5
17.5	26.4	17.4	38.6	17	(20.0)	68.5
		18.3	40.5	18		60.3
		19.4	36.9			60.0

[1] Average of both years.

These tables are a brief summary given by Key, 136 pp., 81 and 313. The discussion in Chapter IX is based on a larger table, and its figures differ somewhat from this. The girls' schools are the private schools of Denmark and the higher schools of Sweden.

Key's book is a most careful study, and should be thoroughly examined.

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The most important abbreviations used in this bibliography are: A. A. A. P. E., Report of American Association for Advancement of Physical Education; Ed., Education; Ed. Rev., Educational Review; N. E. A., Report of National Educational Association; Ped. Sem., Pedagogical Seminary; Pop. Sci. Mo., Popular Science Monthly; Zts. f. Sch. ges. pfl., Zeitschrift für Schulgesundheitspilege.

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